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HOWARD CROSBY WARREN

1867-1934

The death of Howard Crosby Warren on January 4, 1934, at the age of sixty-six years, terminated a long and highly useful career in psychology. Born at Montclair, N. J., June 12, 1867, Dr. Warren as an undergraduate attended Princeton University, obtaining his A.B. degree in 1889; becoming a Fellow in 1889-1890 and receiving his A.M. degree in 1891. The next two years were spent in study abroad at the Universities of Leipzig, Berlin and Munich.

In all, as undergraduate student, graduate student and as member of the teaching staff, Dr. Warren was connected with Princeton University for a total of forty-nine years. For the year 1890-1891 he was Instructor in Logic; from 1893 to 1896 Demonstrator in Psychology; Assistant Professor of Psychology, 1896-1914; and Stuart Professor of Psychology from 1914 until his death. He was also Director of the Psychological Laboratory for twenty years, from 1904 to 1924. This is indeed a long and useful service to a single institution.

In spite of his years of graduate work at Princeton and abroad, Dr. Warren apparently never had the time, or perhaps the inclination, to take his degree of Doctor of Philosophy in the early part of his career. This degree was granted to him as late as 1917 by the Johns Hopkins University. The details of this incident are worth recording because they give an indication of the honesty, fairness, set of values and fine sense of humor of Dr. Warren. He was finally motivated to the obtaining of this degree because he did not think it proper for him to examine Ph.D. candidates without having the degree himself. Obviously any number of universities would have given him an honorary Ph.D. but Dr. Warren always refused any-

thing which he felt he had not earned. So he fulfilled all of the necessary requirements for his degree; he spent the year 1916-1917 in residence at Hopkins where, it is true, he lectured to classes instead of attending them; he presented a thesis which was accepted and he went through the formal final examinations. Of course, these examinations took the form of philosophical and psychological discussions in which one could not tell who was the examiner and who was the candidate.

Dr. Warren's membership in scientific societies shows his wide interests both within and outside the strictly narrow field of psychology. He was a member of the American Psychological Association and its President in 1913 (four years before he obtained his Ph.D.) and of the Society of Experimental Psychologists. He was a Fellow of the American Association for the Advancement of Science; a member of the American Society of Naturalists, of the American Anthropological Association, of the Eugenics Research Association and of the American Sociological Society. His name was starred in the first edition of *American Men of Science*. He was also a member of the National Academy of Sciences. This list of affiliations indicates how Dr. Warren was interested in any cognate science which might throw additional light on the problems of psychology. This wide interest is indicated also by a study of his publications listed in the *Psychological Register*. Dr. Warren's psychological system appeared in 1919 under the title *Human Psychology*. This was translated into French in 1923 and was rewritten in 1930 in collaboration with Dr. Leonard Carmichael.

One of Dr. Warren's outstanding contributions to psychology in general, and particularly to the development of American psychology, was his connection with and development of psychological publications. This began very early in his career. From 1894 to 1907 and again from 1910 to 1914, he assumed the difficult and what must have been the extremely tedious task of Compiler of the *Psychological Index*. It was he who was largely responsible for the classification of psychological topics which was such a necessary step in the arrangement of bibliographical titles. In 1901 Dr. Warren's name appeared on the journals of the Psychological Review Publications as Associate Editor and Business Manager and the next year it was added to the list of Coöperating Editors. In 1904 J. McKeen Cattell, who with J. Mark Baldwin founded the *Psychological Review* in 1894, retired from the editorial board and Dr. Warren was made a Co-editor. In this year the *PSYCHOLOGICAL BULLETIN* was estab-

lished and Dr. Warren was its first editor, holding this position from 1904 until 1910. From 1910 until his death, he was Editor of the *Psychological Review*. In 1916 he established the *Journal of Experimental Psychology* under the editorship of John B. Watson. By 1911 Dr. Warren had acquired control and ownership of the group of journals consisting of the *Psychological Review*, the *Psychological Index*, the *Psychological Monographs* and the *PSYCHOLOGICAL BULLETIN*, to which the *Journal of Experimental Psychology* was subsequently added, and these he brought under absolute unitary control by forming the Psychological Review Company with himself as President. This arrangement continued until 1922 when Dr. Warren offered an option to the American Psychological Association for the purchase of the group of journals at a price far below their actual value. By 1929 the American Psychological Association had paid a little more than 60 per cent of the purchase price, although they were ahead of their schedule of payments. In that year, Dr. Warren very generously presented the rest of the outstanding stock of the Psychological Review Company to the Association, thus cancelling the unpaid notes, so that the Association came into full possession of the Review Company and the group of journals. The care, patience, energy and good judgment which Dr. Warren put into his editorial work is almost unbelievable. Time and again he would carry on with an author a correspondence of many typewritten pages regarding the best form and proper construction of a single sentence.

In the last edition of *American Men of Science*, Dr. Warren describes his own fields of activity as "experimental psychology; bibliography; association psychology; lexicography." His interest in bibliography and lexicography appeared very early and continued all of his life. In 1894 we find him already compiling the *Psychological Index*; in 1901 we find him contributing largely to the *Dictionary of Philosophy and Psychology* edited by J. Mark Baldwin. We find him a member of a Committee on Psychological Bibliography of the American Psychological Association in 1900 and Chairman of that committee in 1901. We find him a member of the Association's Committee on Library Check Lists in 1921; and Chairman of the Committee on the Academic Status of Psychology in 1913. For many years he was Chairman of the Standing Committee on Psychological and Philosophical Terminology of the Association. This interest in terminology culminated in the initiation by Dr. Warren of a *Dictionary of Psychological Terms*, which so largely occupied the

last years of his life. This *Dictionary* will appear as having been written "by many hands" but those who have been concerned with its preparation can testify as to how much of this work was accomplished by Dr. Warren before the material was sent to the contributors. And the work of collating and collecting and of seeing this volume through the press required an expenditure of time, energy and care which cannot be fully appreciated by its users. Fortunately this work had so far progressed that Dr. Warren himself entirely completed all of the galley proof corrections so that the *Dictionary* will appear solely from Dr. Warren's own editorial hand and will remain a lasting monument to his foresight, energy and imagination.

This statement cannot be closed without some consideration of Dr. Warren's personality. He had a courage, a set of values, patience, energy and a sense of humor which might well be taken as a model. As a result of an early injury, he had defective vision for many years, a condition which became progressively worse until, not long ago, he was threatened with total blindness. Fortunately this condition was relieved during the last months of his life. The writer cannot give a better picture of Dr. Warren's personality than to relate the manner in which he told him of the approaching total blindness. One day in his office, Dr. Warren suddenly said: "By the way, I want to tell you about an interesting psychological experiment which I am about to perform. My doctors tell me that I shall be totally blind in six weeks time and it will be an interesting psychological experiment to find out what personal adjustments I shall have to make." This is courage indeed!

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A DESCRIPTION AND CLASSIFICATION OF THE RESPONSES OF THE NEWBORN INFANT*

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INTRODUCTION

The present paper attempts to supply a classified list of those responses of the newborn infant which are known at the present time, together with the available information concerning their stimuli. This list has been arrived at through a careful study of the literature relevant to the topic and is documented accordingly. The primary motive in undertaking this survey was an interest in the maturation of specific human responses, but I have attempted to summarize the results of the study in such a manner that they will be useful to persons holding other interests. An interpretative article will follow.

A survey of this kind scarcely needs an apology. Although several baby biographies have contained descriptions of the behavior of the newborn which may be seen by the psychologist as a bystander and other studies have summarized some of the responses which he may elicit as an experimenter, we have no summary which includes the total behavior of the newborn as known today.†

Without doubt such a summary involves an evaluative element on the part of the author which I will not deny. Nevertheless, the question of whether or not a given response did or did not occur is one whose answer must be trusted largely to the original observer. The evaluative element appears, however, when one must deal with an imperfect description of the response; it enters more deeply when

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The bibliography extends only to Jan. 1, 1931.

† The summary of K. C. Pratt in the *Handbook of Child Psychology* (2nd ed. rev.), and of E. B. Hurlock in *Child Development*, June, 1933, had not appeared when the present article was accepted for publication. Each of these reviews undertakes a somewhat different task than does the present one.

one must decide whether the evidence is sufficient to indicate with certainty the stimulus of the response, for never in the course of infant research has the statistical probability of causal connection between specific response and stimulus been stated. For that reason I present the list of stimuli as of lesser importance than the list of responses.

Before I completed this summary I finished some observational and experimental studies in the newborn ward of the University of Virginia Hospital, a privilege for which I am indebted to Dr. D. L. Royster, Professor of Pediatrics. While my studies are not incorporated in the present article, they furnished an important background of experience which has doubtless influenced the present treatment.

I make no claim to have read every printed allusion to the responses of the newborn. I *have* attempted to read all papers that might be called studies of young infants which have appeared in English, French or German. The present bibliography contains less than one-third of the total literature which was consulted, as all papers not bearing directly upon the responses of the newborn were excluded from it. An effort was made to make the bibliography valuable rather than extensive.

It will be noticed that only a few baby biographies have been included among my references. While nearly all of the biographies were consulted, I have included as references only those which contain data that are not present in any of the larger studies which comprise the body of the references. To have done otherwise would have been to extend the bibliography to an inconvenient length without adding materially to its value.

Some explanatory notes regarding the *content* of the summary and bibliography must be given. In the first place, the subject matter of the paper is limited to the *responses of normal children of the hospital period*—the first ten days. No references to the behavior of premature, post-mature, or pathological cases are included. The exclusion of data on older and younger children means that I shall not consider whether any response is increasing or decreasing in frequency at the time of birth. Nor shall I state what percentage of defined groups of subjects exhibit each of the responses during the neo-natal period. Only in a few cases are these data available in reliable quantity and lack of space prohibits my including them. It is emphasized that this article is in no sense normative. What is desired is merely to determine what responses are capable of appearing in some normal-term infants.

On one subject the bibliography of the present paper is intentionally incomplete. The toe reflexes have an enormous literature of little importance for our present purposes, and from this literature I have selected only a few titles.

Many responses have never received a detailed description. In such cases I have been forced to judge whether the terms have a common significance. As we shall see, this presents one of the serious difficulties of the study.

In organizing the material I have classified the local responses according to the part of the body which performs the response or which predominates in the performance of the response. Responses which involve nearly equally several parts of the body I have grouped as *Coördinate Responses* and within this group I have attempted no classification. Since some responses involve only a part of the body when present in a minor degree but all of the body when present in greater degrees, and since some movements occur in isolation and again as parts of one or more larger responses, it will be seen that duplication of a sort is certain to appear.

The classified descriptive list which resulted from a summary of the literature is as follows:

A CLASSIFIED LIST OF RESPONSES

A. *Eyelid Responses*

1. *Opening the lids.* Bryan (11) found that many infants at birth open their eyes either prior to or simultaneously with other activity. Bárány found that the eyes open during the slow upward phase of vertical nystagmus.

2. *Closing the lids.* This heading includes the tightening of the lids which occurs even when the eyes are already closed. The stimuli to closing the eyes are very numerous, and are as follows: touching the eye-ball, conjunctiva, lids, lashes, forehead, nose, cheeks, and mucous membrane of the nose (Kussmaul, Genzmer, Preyer); sound (Genzmer, Demetriades, Taylor-Jones, Bárány, Peiper [57], Kollreuter, Poli); to strong odors and to bitter substances (Kussmaul, Peiper); it occurs in crying (Darwin) and in sneezing (Preyer). Closing the eyes towards light was found by Kussmaul and many later investigators.

The closing of the eyes is often bilateral, but the contraction may be more pronounced on the stimulated side than on the other. This was observed by Kussmaul and by Raehlmann and Witkowski for tactful stimuli and by Bárány for auditory stimuli.

B. *Pupillary Responses*

In addition to the control of pupil width by light, the narrowing of the pupils upon going to sleep and their widening upon awaking also occur in newborn babies (Gudden, Pietrusky). Bartels discovered that strong cutaneous stimulation causes widening of the pupils at birth.

Pupillary responses are consensual throughout postnatal life (Preyer, Pfister).

I have not been able to find a reference to pupillary movements accompanying convergence in the newborn.

C. *Ocular Responses*

As McGinnis recently has pointed out, most students of infant responses have described eye movements so inadequately that it is difficult to tell just what the responses are. I must therefore include a class of undefined movements.

1. *Pursuit movements.* McGinnis saw pursuit movements at birth.

2. *Saccadic movements.* I again refer to McGinnis' study.

3. *Nystagmus.* Here I refer to a well-known combination of pursuit and saccadic movements. McGinnis photographed optic nystagmus in the newborn.

Thornval showed that nystagmus can be produced by thermal stimulation (20° C.), and Alexander and Bartels demonstrated that rotational and post-rotational nystagmus exist in the newborn; Schur found electrical excitability to be present. In the case of caloric nystagmus, the direction of the nystagmus changes with the position of the infant (Thornval).

4. *Coördinate compensatory eye movements.* McGinnis found them as early as the second day in the case of the infant's own head movements. When the head is jerked quickly, eye movements which are compensatory in direction also occur (Bartels).

5. *Undefined eye movements.* Raehlmann and Witkowski described the eye movements of newborns as being spontaneous and sideward.

Tiedemann, Kussmaul, Genzmer, Watson and Watson, and nearly all other investigators of infant behavior have found that newborn infants turn the eyes toward light. In some cases the eyes turn towards less bright objects at birth. Blanton wrote, "The eyes of many infants followed a slowly moving hand a few minutes after birth."

Undefined eye movements have also been mentioned in new-

borns in response to position changes. Bárány found that if, with the infant in the horizontal back position, the head is held fixed and the body rotated, the eyes turn in the same direction as the body and hold their new position as long as the body position is maintained. As described by Simons, when newborn infants take up an opisthotonic posture upon being held upside down by the feet, the eyes are turned toward the forehead.

6. *Eye position in sleep.* Nearly any position of the eyes may occur in sleep, but the most frequent position in the newborn as in adults is the upward and divergent position (Pietrusky, Bartels).

7. *Coördination of the two eyes.* Donders described a case of coördination from birth. Dearborn found perfect coördination from the first with his child. Likewise Guillaume in the case of his children found a marked tendency to coöordinated movements of the eyes. Blanton, speaking of a large group of infants, reported: "While inequality of eye movements is not uncommon, it is not the rule." A fair amount of coördination is mentioned by Bryan (12). Raehlmann and Witkowski, while denying that the newborn possess true visual coördinations, admit that the two eyes usually move together.

8. *Convergence.* Several authors have described cases of fixation, or convergence of the lines of vision, in newborn children. I may mention Genzmer, Donders, Cuignet, and Gutmann. Raehlmann and Witkowski thought that all convergence was accidental. That seems very improbable, however, in a case such as Cuignet's. This infant, on the eighth day and thereafter, fixated a candle continuously when it was from two to three meters distant and consistently began to squint when the candle was brought to seventy-five centimeters or nearer. The infant kept its eyes closed almost continuously until the eighth day.

9. *Accommodation.* Genzmer got evidence of accommodation by observing the "Lensenbildschön" and found that it varied with convergence of the eyes.

D. *Tear Secretion*

While it is unusual, this response sometimes occurs during the crying of newborns (Blanton). Tears are also secreted upon irritation of the nasal mucosa (Genzmer, Kroner).

E. *Facial and Mouth Responses*

1. *Opening and closing mouth.* Our knowledge of the stimuli to these responses is limited. The mouth is closed in sleep. Kussmaul

observed strong opening of the mouth to follow quinine application. The mouth opens, of course, as a part of yawning and coughing.

2. *Oral position mechanism.* This heading is a translation of a German term (Oraleinstellungsmechanismus). If the upper lip of a hungry baby is touched, it retracts and the mouth opens. If the lower lip is touched, it shortens similarly. Likewise either corner will adjust to local stimulation (Kussmaul, Gamper and Untersteiner). Blanton has given substantially the same description. (See also Fürnrohr.)

3. *Sucking.* The mechanism of sucking has been described by Escherich. It consists chiefly in a downward movement of the lower jaw, with the tongue movement secondary to this. The infant sometimes sucks when no external stimuli are present (Irwin), in which case the stimuli may consist of hunger contractions. Tactual and taste stimuli call it forth (Tiedemann, Kussmaul, Popper).

4. *Grimace, wry face, twisting the mouth.* Kussmaul, Genzmer, Kroner, Peterson and Rainey, and Peiper have used one or more of these terms in describing reactions to bitter, sour, and salt solutions and to pricking of the nose or mouth. I am uncertain as to whether they are distinct from one another, but apparently they are as a class distinct from other facial responses.

5. *Pushing objects from the mouth.* Kussmaul, Peterson and Rainey, and also Bryan (11) recorded it during the first week. Strong bitter, salt and sour solutions are rejected.

6. *Yawning.* Blanton witnessed yawning in one infant five minutes after birth. Dumper's discussion should be mentioned.

7. *Licking or mouthing.* According to Preyer, licking may occur within the first twenty-four hours. It is contained in Irwin's list of the more common responses during the first ten days. I believe this to be the response which is frequently called mouthing (Kroner, Tayler-Jones).

8. *Compressing lips.* A response to certain touches on the lips (Kussmaul, Genzmer).

9. *Pursing lips.* Thomson elicited this reaction by a series of gentle taps above or below the corner of the mouth, given preferably when the child is asleep (Lambanzi and Pianetta). Probably the response to sweet solutions and to touching the end of the tongue is very similar (Kussmaul).

10. *Frowning.* By this term is meant the formation of vertical furrows between the eyebrows. Darwin noticed it repeatedly from the age of one week as a forerunner of crying. Bryan recorded it

within the first ten days as a response to bright light. Peiper observed frowns in response to voice, Bárány during vertical nystagmus. Kussmaul saw frowning as a result of bitter tastes.

11. *Wrinkling of forehead.* According to Preyer this occurs on the first day without apparent cause.

12. *Pulling down corners of mouth.* A response observed by Blanton.

13. *Smiling.* Blanton reported smiles on the first, second, fourth and sixth days. The stimulus in these cases was tickling under the chin. At four days, one subject smiled spontaneously after feeding. Peterson and Rainey saw smiles as early as the fourth day.

14. *Smacking lips.* Pratt, Nelson and Sun listed this among the reactions of the first ten days. Whether this is different from merely opening the mouth cannot be said.

15. *Turning lower lip.* A sign of satiety (Blanton).

F. Throat Responses

1. *Crying.* It may be that crying is somewhat differentiated at birth but I am unable to secure from the literature really descriptive and uncontradictory accounts. The cries are often distinguished only by the situations which call them forth or by the accompanying bodily activity. Irwin was not sure that the regular cry and the hunger cry are unmistakable. Bryan (11) listed three cries: a hunger and discomfort cry, a pain cry, and a rage cry. Bühler also described cries. Hollis has depicted the facial conformation in crying.

Several authors have called attention to the fact that crying in the newborn is usually accompanied by activity of the arms and legs. In this connection, I may mention Bühler and Irwin.

The causes of crying in the newborn are very numerous. A bright light, holding the nose (Genzmer), a loud noise or falling (Watson), stomach contractions (Carlson and Ginsburg), cold, heat and pain (Peiper) are among those stimuli which are well established. The startle reaction, to be described later, often precedes crying.

The hampering of the infant's movements was held by Watson and Watson to cause crying. However, Pratt, Nelson and Sun reported that this crying occurs only seldom to holding the arms. Neither set of experimenters describe their treatment of the baby very fully.

2. *Cooing.* Heard by Peterson and Rainey.

3. *Sobbing.* Bryan witnessed sobbing after excessive crying on the first day.

4. *Sneezing.* Blanton reported sneezing as sometimes preceding

the birth cry. Kussmaul found it elicitable by the vapors of vinegar and ammonia.

5. *Coughing.* Preyer heard coughing within the first hour.

6. *Gagging.* According to Kussmaul, Genzmer and Preyer, gagging may be caused by touching the back part of the tongue or the tonsils. Genzmer and Preyer caused gagging by using asafoetida within the nostrils, Kussmaul by applying quinine.

7. *Swallowing.* Nearly all newborn babies are able to swallow (Kussmaul, Genzmer, Preyer).

8. *Holding the breath.* Holding the breath during a crying fit until the face becomes purple occurs within the first day (Bryan, 11).

9. *Hiccoughing.* Blanton observed hiccoughing at six hours.

10. *Vomiting.* The references are Blanton and Tayler-Jones.

G. Neck Responses: Head Movements

1. *Upward and downward movement of head.* In newborns the upward or dorsal bending seems to occur more often as an active response than does ventral or downward bending. Bárány found that dorsal and ventral head movements accompany vertical rotational nystagmus, but the dorsal response is far the stronger. Dorsal bending was found to be a very frequent reaction to holding the nose (Pratt, Nelson and Sun). Strong odors will also elicit it (Tayler-Jones, Preyer). Peiper secured drawing back of the head by holding the baby in a sitting position and flashing a light in the eyes. Bryan (11) noticed the same retreat from a bright light when newborns were lying on the back. Peterson and Rainey found several infants who lifted their heads dorsally when placed on their abdomen. Schaltenbrand has shown that when some newborns are held by the chest and inclined forward they will lift their heads against the force of gravity.

2. *Turning face to the side.* According to Bühler, newborn infants turn their face aside at nose cleaning and at any strong tactal stimulus. Often they turn their face aside when placed in the abdominal position (Blanton). Babies five to nine hours of age will turn in the direction of a touch on the cheek (Kussmaul, Genzmer, Blanton, Peiper). According to Genzmer, a few exceptional babies turn toward a source of sound at birth. Optically stimulated head movements also occur (Kussmaul, Genzmer, Kroner, Bárány). Gutmann found that whether the head is turned to or from the light depends upon the brightness of the light and the retinal adaptation of the infant. Bartels and Alexander stimulated head movements by

bodily rotation. In this case there is only the slow compensatory movement of the head, not a return movement as in the case of the eyes. The same movements occur during caloric nystagmus (Thornval). Peiper and Isbert found that if a baby is placed on its back and the legs and body are rotated, the head turns in the same direction. If during the rotation of the feet and pelvis, the chest is held firm, the head rotates in the opposite direction.

Turning the face from side to side occurs during hunger or crying periods (Irwin).

3. *Head shudder.* This, as a characteristic response to bitter tastes (Kussmaul), probably differs from the response just described.

4. *Balancing head.* This has been reported as early as two days (Blanton). Peiper and Isbert found compensatory balancing to changes of bodily position, even when the subjects were blindfolded.

H. Hand and Arm Responses

1. *Radius reflex.* Found present in 20 cases in 100 by Müller.

2. *Scapulo-humeral reflex.* Present in 82 cases in 100 (Müller).

3. *Closing hand.* Early observers noticed that the hand of the newborn closed on objects brought in contact with the fingers or palm (Kussmaul, Genzmer, Preyer), but Robinson was the first to measure the strength of the grasp. Only 2 of his 60 cases within the first month were unable to support their entire weight for at least ten seconds. A similar report has been made by Watson and Watson. However, Peterson and Rainey seem not to have found such strength, and Bryan (11) declared that the majority of infants at birth cannot support their own weight by grasping. Perhaps the reason for this disagreement lies in the fact that Watson, and possibly Robinson, occasionally increased an infant's strength by causing it to cry.

Thiemich has observed that the closed hand of the newborn inclines forward (towards the volar surface) with respect to the forearm, while that of the adult inclines backward.

4. *Arm flexion.* A flip of the finger against the hand or a prick with a pin produces withdrawal (Preyer; Peiper, 55).

5. *Rubbing face.* Kroner, and Preyer mentioned rubbing of the face upon itching and tickling. Tactually irritating the nasal mucosa is effective (Kussmaul), also ammonia (Tayler-Jones).

6. *Slashing movements.* This is Watson's term, but we have no description of the behavior thus labeled. Movement during crying is mentioned by Watson and Watson, and Bühler.

7. *Arm play.* There is a common reference to random movements of the arms. It is difficult to understand how bodily movements can be random in the same sense that the responses of dice are random. Champneys furnished practically the only description when he said that the movements were like those of striking.

8. *Startle response of arms.* The hands are thrown outward at almost any kind of strong stimulation. This response, although it sometimes occurs separately, will be considered more fully as a compound response. References will be cited there. Peiper (57) has called attention to the tremor of the arms during the outward movement.

I. Trunk Reactions

1. *Arching the back.* Pratt, Nelson and Sun found that this frequently followed pinching the nose. It will be found again among the compound responses.

2. *Twisting.* If the head is rotated, the shoulders and pelvis twist in the same direction as the head. If the chest is held while the head is rotated, the pelvis twists in the opposite direction from that of the head (Schaltenbrand, Peiper and Isbert). Twisting of the trunk is also a component of squirming (Irwin).

3. *Abdominal reflex.* This reflex was present in some of the newborn infants studied by Cattaneo. With a needle as a stimulus, Farago elicited the reflex in all of his 117 cases.

J. Sexual Responses

1. *Cremasteric reflex.* Aronovitch found raising of the testes present at birth. The stimulation consists in an irritation of the inner thigh.

2. *Penis erection.* Erection was noted by Peterson and Rainey and by Blanton.

K. Foot and Leg Responses

1. *Knee jerk.* Bychowski, Eulenberg, Bechterew, Burr, de Angelis, Farago, Cattaneo, presented evidence of its presence at birth.

2. *Achilles tendon reflex.* Müller and also Burr found it present in some newborn infants.

3. *Flexion of leg.* This reflex is elicited by stimulating the foot or leg, as by a needle (Farago). Leg flexion may be caused by pushing the head toward the chest (Brudzinski-phenomenon, Freudenberg, Peiper and Isbert). Leg flexion is always accompanied by a

plantar flexion of the foot, the reverse of the usual adult behavior (Thiemich).

4. *Extension of the leg.* A gentle push is an efficient stimulus (Tayler-Jones). Bryan (11) found that in some infants this extensor thrust is strong enough on the first day to support the baby's weight (also Peiper, 57). Extension of the leg is accompanied by a dorsal flexion of the foot, the reverse of the adult coördination (Thiemich).

5. *Protective reflex.* Watson and Watson found that when one pinches slightly the inside of one knee, the opposite foot comes up and pushes at the hand. Similarly Bryan (11) found that in holding one foot to test for the Babinski, the free foot almost invariably pushes against the imprisoning hand.

6. *Kicking.* In Irwin's description, kicking consists of "rapid and continuous extensor thrusts alternating with flexions of a somewhat exaggerated type. The legs usually alternate as in pedaling, but sometimes the two legs are extended and flexed together." Kicking occurs during crying.

7. *Stepping movements.* These occur in the infant when it is held upright with the feet touching a surface (Peiper, 57; Tayler-Jones).

8. *Toe phenomena.* While some newborn infants give plantar flexion when the sole is stroked, most of them give extension (Kussmaul, Babinski, Engstler, Peterson and Rainey, Burr).

L. Coördinate Responses of Many Body Parts

1. *Resting and sleeping position.* Peterson and Rainey, Peiper, and Irwin have given almost identical accounts. The legs are flexed, the fists are closed, the upper arms go out straight from the shoulders and the forearms are flexed at right angles so that they lie parallel to the head. On the other hand, Bühler claimed that the fists usually lie below the chin as in embryonic life. This was true in the case described by Brainard, and Peiper (57) recognized this as a common occurrence. Ritter has shown that the flexion of the limbs in rest must be due to greater tonic flexor innervation, for the flexor muscles are smaller than the extensor muscles.

2. *Opisthotonic position.* Strong dorsal flexion from head to heels often occurs in crying newborn infants (Peiper and Isbert). Simons found that young infants held upside down show a general dorsal flexion. Any of the stimuli which release dorsal head bending will also, when strong, release a bending of the spine and extension of the legs.

3. *Backbone reflex.* Galant first described this response, which

consists in the assumption of a concave bending of a side which is tickled or stroked. Peiper and Isbert verified the observation and noticed in addition that the leg of the concave side is extended, the leg of the convex side flexed. This posture also occurs in response to the internal stimuli which are present in pleuropneumonia. Peiper and Isbert found the same response when the infant was supported in the air by a hand under one side.

4. *Lifting head and rear quarters.* Landau observed in older infants that when the child is held horizontally by grasping under the armpits, either both the head and the rear quarters drop or both are raised together. If the head is forced downward, the rear quarters drop also. Simons discovered that while the newborn are not strong enough to completely raise these parts, they do make attempts, and these attempts are coördinated as described above.

5. *"Fencing position."* If one rotates the head, the arm towards which the face is rotated extends, the other flexes. The legs do likewise. Peiper and Isbert have given clear descriptions.

6. *"Springing position."* If the infant is held upright and then inclined slightly forward, the arms extend forward, the legs are brought up (Schaltenbrand, Peiper and Isbert).

7. *Stretching.* The head is bent dorsally, hands are extended above the head, legs also extended (Bühler).

8. *Startle response.* I give this name to a response which variously has been called throwing up the hands or a surprise reaction (Preyer), Umklammerungsreflex (Moro), fear reaction (Watson), Schreckreaction (Cemach, Bühler, Peiper, and others), starting (Bryan). Observers have given much the same description. In most cases the arms go apart, the fingers spread, the legs extend and the head is thrown backward. In a minor degree of the reaction, only the arms may be affected (Freudenberg). Whether crying follows seems to depend upon the intensity and the duration of the stimulus. Freudenberg states that the response can be elicited only if the subject is relaxed when stimulated.

Watson and Morgan described this response as being elicited only by loud noises and falling. Moro and Magnus and De Kleijn before Watson described it as a vestibular response, and Moro gives credit to Preyer. Bryan (11) observed sudden starts of this sort in the absence of any discernible external stimuli, a movement somewhat similar in appearance to the start of an adult in dropping off to sleep. She saw it in nearly all the infants in a quiet isolated hospital ward. Preyer (p. 105) observed it several times in response to touches. Freudenberg stimulated it by stretching the hip and knee or changing

other bodily parts with relation to each other, and by stimulating large areas of the body with hot or cold stimuli. Both he and Peiper held that a blow on the chest or abdomen causes a startle response. Peiper held (57) that it could be elicited by strong stimulation of any receptor, but this has not been proved.

9. *Crying and unrest.* Peiper listed this as a general reaction, appearing upon strong and continued stimulation of any receptor. It is probably equivalent to the mass activity described by Irwin and Weiss.

10. *Creeping.* Creeping in newborns has been most adequately described by Bauer, although Blanton and Bryan have mentioned it also. When placed prone, the arms and legs are drawn under the body, the head is lifted. If the feet are given traction, they push, and thereupon the arms also become active. Each pair of extremities alternates in movement and the spine also alternates its direction of movement.

11. *Shivering and trembling.* Observed by Preyer, Peterson and Rainey, and Blanton. I do not know whether we have here one or two responses. Champneys' infant always gave a slight shiver during micturition, as adults often do.

12. *Extremities extended to the side.* Schaltenbrand has found that if the infant is held upright and rotated about the vertical axis, the arms and legs are extended in the direction of the rotation.

13. *Bodily jerk.* Arms and legs flex strongly and jerk upward in response to loud noises (Poli). Champneys spoke of a spasmotic start, Irwin of a body jerk. I assume that these names refer to the same response.

14. *Supporting bodily weight by grasp.* When this occurs the thighs are brought at right angles to the abdomen (Robinson). Peiper and Isbert found, however, that this is the case only when the head hangs backward. When it hangs forward, the legs are extended.

15. *Sneezing.* Champneys has written concerning his son; "Sneezing was always accompanied by violent movements of all the limbs, the thighs being flexed on the abdomen, the forearms bent, and the elbows thrust forward." According to Preyer, the eyes are closed in sneezing.

A NOTE ON FEAR, RAGE AND LOVE

The names fear, rage and love have been omitted from the list. While no lengthy justification of this decision or any other can be attempted here, I may say that Watson's fear response seems merely to be the startle reflex earlier described by Magnus and De Kleijn. I find no adequate ground for differentiating between Watson's rage

description and that of general crying and unrest resulting from hunger and other causes. In regard to love, I have included cooing in the list. Watson's reports, in so far as they concern the newborn, carry so few details concerning procedure, subjects and results that they seem to be little more than statements of the author's general impressions and theories. However, they are so widely looked upon as the most outstanding studies of the newborn that their minor position in this paper seems to require comment.

INTERPRETATIVE COMMENTS

In a later article I hope to discuss in some fullness the relation of the data which have just been presented to the question of maturation and organization in behavior. I present here only some tentative remarks.

In the first place it seems to me that many of the response forms could not have been acquired by prenatal practice. How can the concept of learning account for nystagmus or the startle reflex? Holt's recent discussion is not convincing when applied to these and other responses of the newborn. It seems equally obvious that many stimulus connections of the responses of the newborn cannot be attributed to a learning process. What prenatal opportunity has been presented for the attachment of caloric stimuli or electrical stimuli to nystagmic or startle responses? The facts demand that behavior development be attributed to a maturation process as well as a learning process.

The above remarks should not be construed to mean that an organism is ever independent of surrounding conditions. All development requires conditions. The argument is that response conditions can be classified as to whether they do or do not involve previous receptor or effector activity of the organism. Apparently previous overt behavior is not the causal agent in the production of some responses of the newborn nor are previous receptor activities the causes of the effectiveness of some stimuli to these responses. Other developmental prerequisites to nystagmic, startle and other reflexes and their stimulus connections must be found. It is the learning explanation rather than the maturational explanation which is the present wastebasket for behavior problems.

In the second place the data of this summary appear in opposition to those theories which hold that the stimulus-response connections of the newborn infant are unorganized, chaotic, unspecific and random. A typical statement of such views of recent date is that by Pratt, Nelson and Sun (p. 211) that any stimulus may release any response. In so far as I can understand such a theory it holds that

no laws can be found to govern infant behavior except that it is unlawful. The authors' own data do not bear out their conclusion. Not only do Pratt, Nelson and Sun fail to utilize their quantitative control data, but practically none of their published data concern specific responses to which the above conclusion apparently refers. Only total arm movements, etc., were studied. The studies here reviewed show, I believe, that stimuli under defined conditions have consistent effects.

Thirdly, the repertoire of the infant does not consist of "a few squirmings." It is a surprisingly large repertoire and each response is by definition "patterned." In infants there seem to be at least fifteen different responses which are total bodily responses; that is, which involve every member. This is in striking contrast to the young *Amblystoma* which possesses only the locomotor and the feeding reactions as general responses (Coghill). This comparison suggests that the number of differentiated responses is directly related to the number of total integrated responses with which the organism begins its reaction history.

Lastly, I may say that while the literature on the newborn is large, it is relatively weak in naturalistic description and in interest and familiarity on the part of the experimenter with the material directly at hand. In most cases the observer has been looking for evidences of receptor or neurological function, or for adult or pathological parallels. A more direct approach may add greatly to the information which has just been summarized.

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EXPERIMENTAL METHODS USED IN STUDIES ON INFANT REACTIONS SINCE 1900

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With the recognition of the importance of research on infant reactions, it may be helpful to present a summary of experimental techniques employed in this field, indicating their nature and the investigators who have employed them; references have also been made to the literature wherein more detailed accounts of apparatus, procedures, and results may readily be found. A critical evaluation of these studies is not intended. At the outset we shall limit the scope of this survey to include only those methods that are as objective as possible.

Much of value has been written from the qualitative point of view. Anderson (3) has suggested certain techniques considered valid in this type of research such as biography, incidental observations, case history, ratings, etc. These methods, involving as they do a certain relatively subjective interpretation, will receive little treatment here. The emphasis will be placed on types of control which may be exercised in investigations of infant behavior.

Whether fortunate or otherwise, infancy is unique in the field of human psychology in its total preclusion of the use of the introspective method. Today the investigator of infant reactions is concerned rather with experimental controls which he may use in his researches. These controls may be classified into two groups: (1) methods of controlling the stimulating situation including in certain cases the measurement of the energy values of specific stimuli, and (2) methods of recording responses. Under the first heading the materials have been classified according to the sense modes. The methods of recording responses have been organized more strictly on the basis of kinds of techniques.

METHODS OF CONTROLLING STIMULI

Visual Stimuli

Experiments in the sensory field of vision may be grouped under four headings for practical purposes: (1) color, (2) light, (3) form, and (4) objects presented visually disregarding quality.

Color. Interested in the infant appeal for different colors, Marsden (64) used cards, 4 by 6 inches, on which were pasted colored papers. Two cards of different hue were held before the child edge to edge, then moved apart. In similar manner crocheted balls of different colors, each 2 inches in diameter, were placed before the child. Valentine (98), interested in a similar problem, adapted Marsden's technique. He used the Holmgren wools (for testing color blindness) and attempted to select colors of standard brightness. As a background for the colors, he held the wools against the gray of his coat at a distance of from eight inches to one foot from the infant's face. The colors used were black, white, red, yellow, green, blue, violet, pink, and brown. After presenting two together and then slowly separating them he reversed the combination. In addition to preference shown, Valentine was interested in the relative time spent in gazing at a single color in a pair.

In a study of color preference Myers (71) used wooden cubes, size 33 by 20 by 15 mm. painted uniformly in different shades of color and placed before the infant on a table covered with black velvet. Staples (91) presented colored discs, standardized for brightness, on a gray background of the same intensity of brightness. Brian and Goodenough (14) sought to determine the potency of form and color in matching by presenting spheres, cubes, cylinders, and two dimensional forms in red, orange, yellow, green, blue, and purple.

Canestrini (18) and Pratt, Nelson, and Sun (76) devised colored light stimuli. The former used Bengal flames, the latter fitted into a flashlight white, yellow, green, red, and blue Wratten filters secured from the Eastman Kodak Company. They calibrated the light intensity and presented the stimuli three times for each color, each period having a duration of four and one-half seconds. Peiper (74) attached colored lights to the forehead of prematures and newborns in order to study the Purkinje effect.

Light. The Shermans (85), studying eye movements and pupillary reflex, moved a dim flashlight horizontally before the child about twelve to fifteen inches from the face, and used a sudden flash for eliciting the latter response. In studying newborn infants Bryan (15) used for the first three days a Winchester Flashlight No. 5911 equipped with an Eveready Unit Cell No. 935, and for the fourth and later days a French Ray-O-Lite charged with Eveready Unit Cells No. 950. For the first three days she focussed the light at one foot but held it three feet from the child's eyes; during the later days she focussed at three feet and used it at that distance. She presented a

momentary flash three times as stimulus, twice while the infant was awake and once during sleep.

McGinnis (68) placed the infant on a crib within a revolving drum of bars which permitted an intermittent flash of light. His problem of eye movements, particularly of nystagmus, necessitated an elaborate apparatus which facilitated control of stimulating conditions. This reference should be of value to one interested in a similar problem. Peterson and Rainey (75) used meagerly described light stimuli: an electric light, a candle, a watch, sunlight, sunbeam, and window light. Jones (55) used the diffused light of a pocket flashlight. Interested in eye coördination, she slowly moved the light from right to left, vertically, and in a counter-clockwise direction, holding the flash twelve inches from the child's face. Tayler-Jones (95) used a "light" stimulus but failed to describe it adequately.

Form. The study of Brian and Goodenough (14) previously referred to is an example of the type of control used for form stimuli. In studying form as opposed to color preference they presented two and three dimensional forms.

Objects Presented Visually Disregarding Quality. In an early study McDougall (67) noted preference for different objects, "wool, yarn, flowers, paper, etc." Tayler-Jones (95) brought a white paper within the field of vision. Jones (55) moved a hand suddenly downward between a light stimulus twelve inches from the face. Blanton (13) slowly moved a hand before the child. Fursey, Bonham, and Sargent (29) studied reaction to light, convergence of eyes, and the following of a moving light but did not describe their stimuli.

Krasnogorski (58), interested in the problem of conditioned response, used the sight of milk in a glass as stimulus for salivary secretion. Reference to the Gesell battery of tests (31) will suggest various uncontrolled visual stimuli: the examiner walks back and forth before the child; a plate held two feet from the child is slowly moved horizontally and then vertically; the infant's blink is studied when a hand or pencil is thrust at it threateningly. Allen (2) used a red cube hidden under a cup in his delayed reaction experiment.

Auditory Stimuli

Auditory stimuli used in experimental work with infants have been numerous, varied, and in general poorly controlled. Peterson and Rainey (75) used a metal rattle, low voice calls, lip sounds, tearing paper, and the falling of a hamper lid. Canestrini (18) used

a harmonica, handclapping, bells, falling objects, tuning forks, shot of a toy pistol, a toy horn, a whistle, whisperings, and other noises. Blanton (13) describes various stimuli: While the child lay on a tiled floor, a metal stool was struck by a door. At a distance of one meter, a metal tray was struck with a fountain pen. Behind the infant's head, a metal disc was struck three times with a hammer. Tuning forks in a box were held near the ear of the infant while crying. In addition, Blanton used a Galton whistle, running water, rattling of paper bags, a whistle, and the dropping of scales. Peiper (74) used an electric bell.

In studying the infant soon after birth, Forbes and Forbes (28) used the "soft notes of a distant gong" while the child was nursing. They also attempted to stimulate the infant *in utero* with a metallic sound. Peiper (74) also studied auditory sensitivity of fetuses. Tayler-Jones (95) used a snapping beetle held within one inch of the child's ear while asleep and awake. Aldrich (1), studying conditioning in infants, rang a small dinner bell at half-hour intervals as a conditioning stimulus.

It is well known that Watson (106) conditioned infants to the sound of a steel bar struck with a hammer near the infant's head. In addition, Watson mentions the banging of a pan, a window shade racing upward, the fall of a window screen. Krasnogorski (58) and Marquis (63) also used auditory stimuli for purposes of conditioning; the former used a bell, the latter a buzzer. Fursey, Bonham, and Sargent (29) do not describe the bell, clang, and whistle they used in their experiment.

Attempts at standardization or control of auditory stimuli are found in the studies of Bryan (15), Pratt, Nelson, and Sun (76), Irwin (43), and Haller (36). Bryan used a "hand bell" of approximately 512 vibrations, one octave above middle C, held one and one-half inches from the child's ear. A Galton (Edelmann) whistle with pitches "of ten, fifteen, twenty-five and thirty-five thousand vibrations" was used. Each stimulus was presented three times, twice per day, while the child was asleep and awake. The whistle was held one inch from the child's ear. Pratt, Nelson, and Sun (76) attempted to calibrate several stimuli by determining the distance at which they could be heard by several observers. These stimuli were the striking of an empty coffee tin, a snapper, an electric bell, a Chinese wooden bell, and a tuning fork. These they arranged in a scale of relative loudness from greatest to least, in the order given above.

Irwin (43) used the tone of a loud speaker placed four inches

from the crown of the infant's head. A tone of 581 cycles was used for a duration of .07 second; the intensity was sufficient to cause a startle in adults. The stimulus duration as well as the response was reproduced graphically. Haller (36) used a 2-B Western Electric Audiometer, connected through a 34-A Western Electric Amplifier with a Western Electric Loudspeaker having a range of seven tones (64-819) with four intensities and a diameter of 21 inches. The loud speaker was set at a distance of five and one-half feet from the subject; the intensity was increased three times by regular intervals (sensation units) until the fourth or maximum intensity was reached.

Gustatory Stimuli

In studying reactions to taste stimuli Peterson and Rainey (75) used a concentrated salt solution, a 1 per cent solution of acetic acid, simple syrup, and tincture of gentian. In addition to diluted cow's milk and mother's milk, Canestrini (18) used for sweet a 2.5 per cent solution of sugar, for sour a 2.5 per cent solution of vinegar, for salt a 2 per cent salt solution, and for bitter a 2 per cent solution of quinine. Tayler-Jones (95) placed a few grains of salt inside the lower lip. Bryan (15) used mother's milk, the milk of another mother, cow's milk, and lactic acid.

Pratt, Nelson, and Sun (76) used sterilized round nursery applicators with a tip of absorbent cotton dipped in their solutions, and touched at the child's mouth. They kept their solutions at between 20 and 270 degrees centigrade. The solutions were 16.66 per cent sugar, 8.33 per cent salt, .25 per cent quinine, 2.14 per cent citric acid. Distilled water was used as a control. Jensen (51) used milk at temperatures above and below 40 degrees centigrade, sterile water, 6 per cent glucose, .90 per cent salt, .45 per cent salt, .30 per cent salt, .225 per cent salt.

Olfactory Stimuli

The investigators who studied reactions to taste stimuli also reported investigations of smelling sensations in infants. Peterson and Rainey (75) used as olfactory stimuli asafoetida, compound spirits of orange, oil of rose geranium, tincture of gentian, and mother's milk. Canestrini (18) used twenty chemicals in addition to cow's milk and mother's milk among which were asafoetida, oil of peppermint, oil of cloves, camphor vinegar, lavender, chloroform, musk, absinthe, amyl-nitrite, oil of turpentine, paraldehyde, and oil of mustard.

Tayler-Jones (95) soaked a cotton pledge in mother's milk, then in aromatic spirits of ammonia. Pratt, Nelson, and Sun (76) took great pains to devise a method for administering odors. Reference to their study is well worth while to the student interested in studying olfactory sensitivity. Through the use of an olfactory pump they were able to blow a small amount of vapor into the infant's nostril. Their stimuli were two drops each of valerian, acetic acid, oil of cloves, ammonia (5 c.c. of 28 per cent ammonia in 25 c.c. of water).

Cutaneous Stimuli

Pain. Canestrini (18) used for pain stimuli pricking the child with a needle and an electric current. Blanton (13) mentioned several uncontrolled stimuli such as mechanical stimulation of the umbilical cord with newborns, circumcision, pricking the wrist, etc. Peiper (74) used a pin prick for pain stimulation. Tayler-Jones (95) pinched the foot and the skin inside the knee. To elicit a "pain" emotion Sherman (86) pricked the cheek of the infant four to six times with a needle. Jones (54), studying conditioning in infancy, stimulated the child's skin with electrodes from a Porter inductorium with rheostatic control on the secondary circuit, and with an adult hooked into the circuit to act as control.

Although not primarily interested in sensitivity to pain, Richter (80) also used an electrotactile stimulus applying electrodes to the palm and dorsal surface of the hand.

Pressure. Calibration of stimulus value has been exceptionally rare in the field of pressure sensitivity in experiments with infants. Canestrini (18) stroked the surface of the skin with a finger and a brush, and touched the lips with various objects. Tracy (97) stroked the cheek of the infant once with a tongue depressor or a match. Blanton (13) rubbed the skin surface and touched the hands with objects to elicit grasping responses.

Wagoner (102), interested in the problem of whether or not the child could be lifted by an adult's finger casually placed in the infant's palm, replaced the finger with a rod. In the Tayler-Jones experiment (95) the hands were pressed firmly against the soles of the infant's feet. Mateer (65), also studying conditioning, allowed the contact of a blindfold over the child's eyes to act as secondary stimulus. Denisova and Figurin (24) permitted the position of the mother's breast in relation to the infant's mouth to act similarly. It is difficult to determine whether or not this stimulus resolves itself simply into the category of pressure stimuli.

Although they did not use the instruments specifically for determining the infant's sensitivity to stimuli of pressure, the styluses adapted for experimental use in study of the Babinski phenomenon by Pratt, Nelson, and Sun (76) and by Waggoner and Ferguson (101) provided a more objective device for control of pressure stimulation.

Temperature. Controls of temperature stimuli are practically unused in infant work. Canestrini (18) used as cold stimuli application to the skin surface of ethyl chloride, alcohol, and a current of air. Blanton (13) used "dampness," "warmth and cold," and alcohol. In their study of physiological conditions in infancy Demuth, Edelstein, and Putzig (23) attempted to hold humidity and temperature constant. Pratt, Nelson, and Sun (76) applied a cold cylinder to the inside surface of the knee. In addition they devised a thermostatic device for controlling temperatures of liquids, then introduced the liquids into the mouth with a medicine dropper. Reference to their study for acquaintance with the device used should prove profitable.

Organic Stimuli

Most investigators in this field have assumed that by holding constant external stimuli, reaction should rightfully be interpreted as response to internal stimuli, probably organic in nature. The conclusions drawn by Irwin (42) sum up this viewpoint rather clearly. Wada (100) and Carlson and Ginsburg (19) in their classic studies of hunger contractions found evidence for the conclusion that stimuli for these muscular responses correlated rather definitely with time elapsed since last feeding. Sherman (86), studying the nature of emotional responses, allowed the subject to go fifteen minutes beyond the regular feeding time. Mention should be made here again to the studies of Krasnogorski (58), Mateer (65), Denisova and Figurin (24), and Marquis (63), each of whom studied conditioning of feeding responses by presenting food to the subjects and then attempting to elicit such responses by presenting auditory and tactal stimuli.

Siemsen (90) has given a good bibliography of studies of gastric motility and the development of chronic anorexia, as related to excessive milk feeding. Hull and Hull (38) kept a graphic record of the progress of one subject in the development of bladder control, and Scoe (84) studied the records of a group of infants in an investigation of the same problem. It is possible that contact with the toilet seat might be considered the stimulus here, although most studies of

bladder control emphasize the organic stimulus to greater extent than they do the external contact stimulus.

Stimuli for Reflexes and General Activity

Those studies indicated bibliographically with an asterisk are a few of the better known investigations dealing with several responses. The test items of the Gesell schedules (31) might be considered as stimuli for such responses, though for experimental purposes involving calibration they are not well adapted. Fursey, Bonham, and Sargent (29) used such items in an inventory of behavior, seeking to study the presence or absence of a general factor in response. Blanton's (13) study mentions a host of stimuli of all sorts, though none are well standardized. Irwin (42) emphasized the importance of "mass activity." In an effort to control conditions of stimulation, Irwin eliminated as far as was possible all types of stimuli of an external nature and controlled conditions of temperature, humidity, sound, and light by using a stabilimeter within a rather elaborate cabinet arrangement. A similar attempt was made by McGinnis (68) in the study of nystagmus and eye movements mentioned above. Gesell (32) has described in some detail the apparatus used in the Clinic of Child Development at Yale. Such studies indicate a developing emphasis on control of all stimulus conditions.

Babinski Phenomenon or Plantar Reflex. Studies of the Babinski toe response have been legion; however, adequate description of methods of stimulation has been surprisingly limited. For sake of convenience this topic will be considered under two divisions: (1) condition and position of the infant, and (2) methods of stimulation. The report of an investigation by Wolff (107) gives an excellent summary of the literature regarding both stimulus and response.

In regard to the condition and position of the infant, Fleischner (27), Rosenblum (81), and Wolff (107) suggest that the infant should be lying down quietly, with the leg exposed and with shoes and stockings removed. Preferably, the subject should be awake. Attention of the child should be distracted. Waggoner and Ferguson (101) believe that in order to keep the labyrinthine and neck responses a constant factor the infant should have its head turned toward the side stimulated.

Kalischer (56) and Wolff (107) emphasize the fact that the foot should not be cooler than the rest of the body, since coldness tends to diminish the normal response. Kalischer suggests also that the

legs of the infant should be placed across the knees of the experimenter. Cohn (20) states that the leg should be held firmly since the movements of the foot tend to mask the movements of the toes. Legs and feet of the infant should be touched as little as possible during the test (107).

The methods of stimulation used indicate that almost all writers agree that stimulation should consist roughly of a longitudinal stroking. Pratt, Nelson, and Sun (76) used a heel-to-toe stroke; Fleischner (27) alternated between heel-to-toe and toe-to-heel strokes. Babinski (5) suggests that the response is elicited more readily by striking the outer rather than the inner border. Fleischner stroked first the outer and then the inner border. Waggoner and Ferguson (101) divided the sole into quadrants and stroked each until the characteristic response was called out. Pratt, Nelson, and Sun (76) stroked only the median line. Wolff (107) agrees with Fleischner (27) and Engstler (26) that the foot should be stroked only once; Pratt, Nelson, and Sun stroked each foot three times. Waggoner and Ferguson (101) kept stroking until they had a response or were sure that none could be called out. All investigators agree that the stroke should be light.

Suggestions are made in three investigations relative to the instrument used for stimulation. The finger has been used in the majority of cases. Wolff (107) feels that the smooth handle of a reflex hammer acts as satisfactory stimulus. Pratt, Nelson, and Sun (76) devised a stylus-applicator so regulated by a spring that it released a pressure upon stroking of between 2.5 to 3.5 grams, usually about 3 grams. Waggoner and Ferguson (101) used a stimulator with a wax point which left an imprint on the stimulated sole. The stylus was attached to a spring handle, about which a sleeve was placed in such a way that with the sleeve in a given position as regards the spring, the strength of the stimulus was believed to have a constant value.

Grasp. In many of the experimental studies with infants, objects have been presented in order to observe response to such stimulus. It would be legitimate to classify such stimuli under the headings of visual and tactful. For purposes of this discussion, however, we have classified such stimuli according to whether or not they were used primarily to study visual or tactful stimulation, or a response to the stimulus as a whole, in a pattern of "grasp." Studies by Myers (72), Lippman (60), and Halverson (37) sought primarily to study the grasp response. Myers gave little or no description of

objective value relating to the stimuli employed. Lippman offered objects to the child. Halverson used red cubes in a comprehensive study of the grasping phenomenon. The child was seated at a table 30 inches high with a top surface 20 by 30 inches. Three situations of three seconds each were used.

Sucking. Stimuli for sucking responses have been very inadequately calibrated. Blanton (13) noticed sucking, lip, and swallowing responses to various types of stimuli. Fursey, Bonham, and Sargent (29) placed a nipple in the infant's mouth. Krasnogorski (58), Mateer (65), Denisova and Figurin (24), and Marquis (63) in a study of conditioning used food stimuli. Kasahara (57) and Jensen (51) used specially designed feeding bottles. An elaborate monometer system was devised to control the pressure volume in the feeding bottle.

Smiling. Washburn (103) studied smiling in infants using varied and noncalibrated stimuli. Her bibliography includes mention of important studies in this field.

Crying. In the course of giving mental and physical tests, Bayley (9) observed crying. No stimuli for that specific response were used.

Studies of Special Activities

Sleep. Surprisingly few stimuli have been employed in investigations of sleep. Canestrini (18) used an electric current. Peiper (74) measured the reaction time, noted response to pain stimuli during waking and sleeping, and compared results. He gives in addition a good summary of the literature relative to sleep. Bühler (16) and Pratt, Nelson, and Sun (76) used no stimuli specifically for study of this phenomenon, but recorded in their investigation the amount of time per day the infant spent in sleeping. Bryan (15) employed his stimuli during sleep as well as waking. These stimuli have been mentioned under their appropriate headings.

Posture. Studies of posture in infancy have been made by Blanton (13), Jones (55), Peiper and Isbert (73), and Schaltenbrand (82, 83). Blanton supported newborns on the lap, holding them above the umbilicus. Jones placed the infant in a sitting position, with the legs straightened and placed at an angle of about 50 degrees. Peiper and Isbert inverted the infant, placing the head in different positions relative to the trunk in studying labyrinthine and tonic neck reflexes. Schaltenbrand placed the infant in a dorsal position flat on the surface of a table.

Walking. Although walking has been studied by many investi-

gators, few stimuli for the response have been used. Burnside (17) suggests persuading the child to walk by offering him toys at a distance.

Language and Social Behavior. Although stimuli have been used but slightly for language responses, Blanton (13) reports that children were placed together, one crying, to see the effect on the others. Bühler (16) used the same method with her group.

Emotions. It seems best in this report to include stimuli for emotional responses under the responses which they were designated to elicit: (1) fear, (2) rage, (3) pain, (4) love, and (5) hunger.

In order to obtain a fear response Blanton (13) dropped the child suddenly, as did Sherman (86, 87). Watson and Morgan (104) used this stimulus, as well as sounding an iron bar close to the child's head and allowing a beam of bright light to penetrate suddenly a dark room. Irwin (45), in addition to dropping the infant, accelerated the child upward. He also observed the so-called fear responses to loud sounds of an intensity less than that given by the iron bar (43).

Watson and Morgan (104) hampered movements to elicit rage. Sherman (86, 87) restrained the head and face. Pratt, Nelson, and Sun (76) held the infant's nose between the thumb and index finger so as to shut off the nostrils for ten to fifteen seconds.

To secure a response to pain Sherman (86, 87) pricked the cheek a few times with a needle. Jones (54) used an electrotactile stimulus.

For a love response Watson and Morgan (104) stimulated the "erogenous zones" by stroking.

Sherman (86, 87) allowed the infant to go fifteen minutes beyond feeding time to obtain a hunger response. In connection with judgments of emotional responses, Goodenough (34) mentions the Buchner pictures of infants who had been subjected to stimuli supposed to call out responses judged to be emotional.

Conditioning. Conditioning experiments with infants have been conducted according to the method of Pavlov. For salivary secretion Krasnogorski (58) used as stimulus the sight of milk in a glass and a bell for conditioning stimulus. Mateer (65) presented chocolate to the infant for feeding response, and used a blindfold over the eyes for secondary stimulus.

Denisova and Figurin (24) used food as stimulus and the position of the mother's breast as conditioning stimulus. Watson and Rayner (105) used as stimulus for fear the sudden sound of a hammer striking an iron bar, and for conditioning stimulus "indifferent

objects" such as a dog, rabbit, cotton, masks, hair. Aldrich (1) scratched the sole of the foot firmly with a pin for a stimulus, and used the sound of a dinner bell as conditioning stimulus. Jones (54) used an electrotactual stimulus and a bell, a buzzer, or an intermittent flash of light for conditioning stimuli. Marquis (63) used milk from a nursing bottle and as conditioning stimulus a buzzer two and one-half feet from the infant's head.

Delayed Response. In studying delayed response Allen (2) adapted the Hunter technique by presenting three cups to the child under one of which was hidden a red cube.

METHODS USED FOR RECORDING RESPONSES

As has been suggested earlier in this paper it is, of course, entirely impossible to secure introspections from infants. Consequently, investigators in this field have had to resort to various methods of measuring responses, such responses being largely of the gross bodily type. It is our purpose here to deal with those experiments which have utilized recording methods relatively objective in nature. It is not to be implied, however, that studies which have used entirely observational methods of recording reactions have been of little value. Many of the older biographical studies such as those of Shinn (88), Major (62), Tiedemann (70), Darwin (21), and Taine (94) made important contributions. Indeed, Watson's work (105, 106) in conditioning and in the field of the emotions was of this type; other well known studies, some of recent date, have used this method with large measure of success (13, 15, 75, 95).

We find important work in a number of fields if we review those studies which employ as methods for measuring response those which lie between the purely subjective interpretation on the one hand, and extreme "brass instrument" technique on the other. Students of eye movements (55, 32, 95, 29) have sought to limit their observations to specific responses, disregarding others. This method has been used by Tracy (97) in an interesting study of change in skin color subsequent to striking; by Bühler (16), Pratt, Nelson, and Sun (76), and others with sleep; by Watson (106) with emotions; by Hull and Hull (38) and Scoe (84) with development of bladder control; by Emdin (25) with vomiting; by Hull and Hull (38) with development of language; by Blanton (13), Hunt, Johnson, and Lincoln (39), Bayley (9) with crying; Baldwin and Stecher (6), Peiper and Isbert (73), Jones (55), Bryan (15), and Shirley (89) on development of posture and locomotion; and by Krasnogor-

ski (58), Mateer (65), Denisova and Figurin (24), and Aldrich (1) in observations of conditioning.

Modifications of the method so as to utilize the "response of no response" and scale methods are exemplified in the studies of Gesell (31) and Fursey, Bonham, and Sargent (29) for various responses; by Sherman (86, 87) for pupillary reflex and other eye movements; and in studies of color and form preference by McDougall (67), Marsden (64), Myers (71), Valentine (98), Brian and Goodenough (14), and Staples (91). Haller (36) used a four-point scale for judging response to auditory stimuli.

Various experiments have employed useful codes of classification for responses noted. Blanton (13) classified responses as being } buccopharyngeal, pelvic, ocular, facial, head, arm and hand, leg and foot, general, responses to noxious stimuli, to dermal stimuli, to kinesthetic stimuli, and responses in connection with feeding. Pratt, Nelson, and Sun (76) and Irwin (42) used a classification of responses under headings of preliminary date (such as name, date, temperature, asleep or awake, wet, etc.): posture, head and face, sounds, arms-legs-hands-feet, and general bodily movement. For purposes of recording, they devised a code of letters and figures.

Responses to plantar stimulation have been classified by various observers. Fleischner (27) limited his observations to movements of the toes, and in response only to the first stimulation. Bing (12) noted (1) the "pure Babinski," (2) extension of all the toes, (3) simultaneous twitchings in the tensor fascia lata, adductores, or quadriceps femoris, (4) retraction of the whole leg (flexion of the foot), (5) tensor muscle of the fascia lata, (6) adductor and quadriceps crural muscles, (7) movements of defense (such as flexion of limb, hyperextension, rotation, abduction), and (8) general response. In summarizing these studies, Wolff (107) classified responses as (1) plantar response, (2) Babinski, (3) dorsal extension of the toes, (4) no toe response, (5) mixed reactions, and (6) asymmetrical responses.

Timing devices have been used in most of the experimental work with infants. These are often of chronoscopic and automatically recording type and will be mentioned in connection with the more objective methods of measuring response. Mention should be made of the chronametric studies of Banu, Bourguignon, and Laugier (7), and of Banu and Bourguignon (8). Bühler (16) timed features in the behavior of the infant with a watch, and calculated percentages of total time spent in various activities. Valentine (98) noted with a

stop watch the amount of time the infant spent in gazing at one or another of a pair of colors presented simultaneously. Staples (91) timed the visual fixation on colored discs. In studying posture Jones (55) recorded the time an infant was able to sit unsupported. Baldwin and Stecher (6), when investigating walking, recorded the time required for the subject to traverse a measured distance.

The studies of conditioning by Watson and Morgan (104), Mateer (65), Krasnogorski (58), Aldrich (1), Denisova and Figurin (24), Jones (54), and Marquis (63) naturally involve consideration of temporal factors such as time of response, number of repetitions required for response, etc. Hunter (40, 41) was the first to study the delayed response with children. Allen (2) used one hundred one-year-old children in a similar experiment. A stop watch was used for purposes of timing.

In a valuable review of the literature up to 1929 regarding the means of recording sound reactions, McCarthy (66) suggests the use of the stenographic technique (preferably the International Phonetic System) for more accurate subjective recording of infant sounds.

In considering automatic recording of response we find a number of devices which have been used with varying degrees of success in infant work. Studies of a number of responses have used some form of kymographic apparatus, allowing for both quantitative measurement and qualitative judgment of response. Blanton (13) reports the fact that she obtained breathing curves in her investigation. Canestrini (18), in his comprehensive survey of sensory factors in infants, had breathing recorded by using a pneumograph and fontanelle pressures by using a similar device. Peiper (74) measured reaction time kymographically. Meyers (69) attached a kymograph to an apparatus for measuring the toe response to plantar stimulation. Marquis (63) had chin movements in sucking during feeding stimuli recorded automatically.

Krasnogorski (58) measured feeding responses kymographically by hooking up a marcy tambour to the chin and to the thyroid cartilage or hyoid bone. Carlson and Ginsburg (19) inserted into the stomach of the infant a balloon for measuring stomach contractions, and had the curves recorded automatically. Wada (100), studying a similar phenomenon, attached a tambour to the bottom of the bed or crib. (It is a question as to whether this study should or should not be included with those which measure bodily activity.) Pratt, Nelson, and Sun (76), Irwin (42), Jensen (51), and Marquis (63)

used the stabilimeter for measuring activity of infants. This was a device whereby the movements in two directions of the surface upon which the infant lay would record themselves automatically on a polygraph.

The motion picture camera has been a favored device for recording infant responses. Gesell (32) has used the cinematic method extensively. Schaltenbrand (82, 83) used this method in studying posture and locomotion as did Burnside (17). Burnside suggested that the effect of the noise made by the camera might be reduced to a minimum by using constantly the hum of an electric motor. After recording the responses with the camera, Burnside later drew pictures from the individual frames as characteristic postural responses.

Sherman (86, 87) took moving pictures of infants who had been stimulated in such ways that it was believed they would respond emotionally. He then presented pictures of the child being stimulated and responding, though in some cases he purposely presented the response pictures after the picture of a situation of stimulus designed to call out a different response. In this way he was able to study the effect upon the judges (students of various kinds) of knowledge of stimulus, etc. Moving pictures of responses have been used by Washburn (103) in studying smiling, McGinnis (68) with eye movements and nystagmus, Waggoner and Ferguson (101) with the plantar response, and Halverson (37) in studying a grasp-response. Irwin (44), using the motion picture camera, has followed the development of opisthotonus and anti-gravity patterns during the first year of life.

Bryan (15) photographed muscular responses in his inventory of infant behavior. Goodenough (34) studied students' judgments of infant emotions by presenting the Buchner series of pictures of infants, which had been taken just after the subject had been stimulated in a way that was believed to call out an emotional response. Bayley (9) recorded photographically reflexes indicating motor development and some physiological and anthropometric measures.

Records of sound reactions on the part of infants have been used but little. Blanton (13) made gramophone records of infant sounds. Sherman (86, 87) had infant cries, subsequent upon stimulation, judged by students as to emotional connotation. McCarthy (66), in a careful review of devices useful in recording sound responses objectively, suggested the photographing of sound waves and the use of victrola and dictaphone records.

Objective measurements of walking and locomotion have been

made by having the footprints record themselves. For this purpose Vierrdt (99) devised specially designed shoes to which were attached three vertical hollow cylinders; these were filled with different colored dyes. Burnside (17) designed a pad on which the child walked, so arranged that the footstep would cause pressure of an ink pad on paper. Shirley (89) greased the infant's feet with olive oil and had him walk on white paper; lampblack sprinkled over its surface after the performance brought out the footsteps plainly. They were then measured for width and distance of step, angles, sequence, pigeon-toeing, and other qualitative observations.

These devices for measuring directly the quantitative aspects of the steps taken by the infant have been supplemented in various ways. Hunt, Johnson, and Lincoln (39) divided a board into four divisions and placed it five inches above the floor. The child was asked to walk its length; each step off each division was recorded. Baldwin and Stecher (6) marked off a board in such a way that, when it was placed vertically as a background in front of which the child walked, a record of time and of qualitative observations could be kept.

The galvanometer, popular in so many psychological investigations of adults, has been used but slightly with infants. Peiper (74) used the instrument to test whether or not the response was present in early infancy. Jones (53, 54), attempting to study the possibility of conditioning infant emotions, used the galvanic deflection as his criterion of emotional response, stimulating the child electrotactually as has been pointed out earlier. He attached the galvanic electrodes to the feet. Richter (80) used an Einthoven string galvanometer when studying resistance of the skin in various parts of the body.

Demuth, Edelstein, and Putzig (23), experimenting with the effect of heat on infants, administered various objective tests of weight, body temperature, pulse, respiration, blood, motility and acidity of stomach, amount of bacteria, acidity and nitrogen and ammoniac content of urine, and of the functions or organs by administration of beet and grape sugar solutions.

Techniques involving both observation and automatic record naturally found their way into experiment with infant's emotions. Bodily movements, facial expressions, and cries were regarded as indicative. Watson (106) studied his famous trilogy—fear, love, and rage—using a purely observational method. In two suggestive studies, Sherman (86, 87) attempted to have emotions of infants, as expressed in photographs and in crying, judged by students of various

types. Goodenough (34) used a similar technique. Jones (54) used the galvanic technique traditional in the studies of emotions. Washburn (103) studied only the smile and laugh, using a cinematic observational technique. Crying has been observed carefully by Pratt, Nelson, and Sun (76), Irwin (42), Sherman (86, 87), and many others.

Little objective work has been done in the realm of social behavior of infants. Bühler (16) and Berne (10) provide valuable observations regarding this type of response.

REFINEMENTS OF METHODS

Statistical Devices

The difficulty met by the investigator of infant reactions in securing sufficient numbers of cases and observations to make elaborate statistical techniques valid is well known. In a few cases, such as in the development of baby tests by Linfert and Hierholzer (59), Gesell (31), Stutsman (92, 93), Bühler (16), and others, statistical methods of standardization have been put to some avail. It is interesting to note the various investigations of such factors as sex and race differences in infant groups by Pratt (79), Davenport and Steggerda (22), and Gatewood and Weiss (30). Gesell (32) made much of his developmental or comparative method as basic to the development of diagnostic tools.

Particularly interesting to mention is the study by Furfey, Bonham, and Sargent (29) of a "general factor" in infant responses. They obtained intercorrelations between reactions such as withdrawal, grasping, patellar, eye movements, and the like and determined the reliability of each test and the interrelationship with other factors. Aoki (4) correlated age of walking with later mental test scores, and with school progress.

Method of Co-Twin Control

This method, also devised by Gesell (33) and described by him as a useful scientific instrument, stands or falls as we regard the relative identity of so-called "identical twins." It would seem a hasty gesture to place too great reliability upon results secured from this type of investigation since studies of twins, adult as well as infant, do not agree as to the equality of all factors. If the technique is a valid one, it offers a rare method of studying maturation from the behavioral angle.

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* General comprehensive study including several responses.

APPENDIX

It seems appropriate to the authors to make brief mention of additional studies which have appeared since the acceptance of the body of the paper.

Studying visual pursuit with a group of white and colored children, Beasley (2) placed the infant in a special cabinet with crib enclosed, and used three types of stimuli. A flashlight, the bulb of which was covered with three layers of tissue paper so as to afford a diffuse light, was moved against a dark background. "Fluttering, flickering, or moving fingers," and a dark blue cylinder, two centimeters in diameter and seven inches long, were moved in a "fairly illuminated field." An improved qualitative device for recording movements in terms of angles was used.

Studying adaptive behavior in infants at seven age levels, Richardson (8) presented several strings to one of which was attached a brightly-colored toy. The strings were arranged in various configurations, and the experiment was carried out in such a way that the infant was unable to secure the toy without pulling the string.

Halverson (4) and Castner (3) have done further work on grasping, using the former's technique. Herrman (5) studied the effect of artificial foods administered above and below 37 degrees centigrade, the temperature of mother's milk. A further study was carried out by Bayley (1), who studied the influence on crying of various situations at different age levels: mental tests, undressing, physiological tests, skin reflexes, motor tests, anthropometric measurements, postural reflexes, measurements of weight and length, and dressing. Wolowik (10) studied the elicitation of crying responses by using stimulating currents of varying amperage.

In a suggestive study on sleep, Marquis (7) secured an "automatic minute-by-minute record of all major movements, made by means of <an> apparatus attached to the bed springs and in circuit with a polygraph," sensitive to "any movement as large as the movement of head or limb of a 13 pound infant." Johnson kinetographs (6), apparently as sensitive, recorded movements at night. Volkelt (9) reported an arrangement whereby, through the use of mirrors, children's behavior may be photographed from two directions with the use of one camera.

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EXPERIMENTAL INVESTIGATIONS OF CHILDHOOD PLAY

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Students of child psychology have emphasized the periodicity of the play behavior of children of different ages and have investigated the forms of play which are characteristic of each age. It is the purpose of this paper to bring together in systematic form the studies which relate to the play of the different stages of development from birth to maturity.

Among writers, there is no agreement as to how many play periods there are in the child's development, what names shall be applied to these periods nor how long each one of them lasts. Among the best classifications of age periods in play behavior are those of Baldwin (8), Croswell (31), Curtis (32), Gulick (50), Johnson (66), King (70), Kirkpatrick (71), Lee (72), Lehman and Witty (80), Pyle (103), Puffer (102), Reaney (104), and Wood (128).

Several investigators have attempted to explain the periodicity of play in terms of its causes. Lee (72), Waddle (123), and Norsworthy and Whitley (98) ascribe the different plays of different ages to "instincts." Blanchard (10) and Gulick (50) maintain that the child's play interests depend upon chronological age, physiological age, mental age and environmental situations. Lehman and Wilker-son (78) report that chronological age is more powerful than mental age in determining the child's play behavior. Reaney (104) has sub-divided the play of the childhood years into four different periods, based upon chronological age. Many investigators have stressed the fact that the transition from one form of play to another is gradual and often barely perceptible. Curtis (32), Lee (72), and Lehman and Witty (80) point out that the different play periods are not separated by distinct dividing lines.

In the classification of play, the following stages of development have been arbitrarily used by the writer: (1) Babyhood (birth to three years); (2) Childhood (three to six years); (3) Youth (six to eleven or twelve years); (4) Adolescence (eleven or twelve to twenty-one years).

1. BABYHOOD PLAY (Birth to Three Years)

For the sake of simplification, the studies summarized here will be classified under different topic heads.

a. *Types of Play*

During the first year the baby, in experimenting with the different sense organs, derives great satisfaction from their stimulation. Major (92) points out that the desire for sensations leads to the baby's earliest play. Fenton (36) has given a month to month summary of the characteristic play at each month level. Freeman (39) divides early babyhood play into three classes. Waddle (123) emphasizes the fact that the play of babyhood is characterized by sensory and motor experimentation. Stern (115) states that to the age of three months, the baby plays almost exclusively with his own limbs; after that age, he begins to play with objects. Norsworthy and Whitley (98) point out that at first the large muscles play a dominant rôle in the spontaneous play of the baby, while later, the smaller muscles are called into activity. Shirley (111) has divided babyhood play into different levels, each level determined by the motor development.

Appleton (5), Arlitt (6), Bowen and Mitchell (18), Gulick (50), Johnson (66), Lee (72), Wood (128) and others all point out that early babyhood play is simple and subject to constant repetition. From about the age of eighteen months, the play of the baby is largely imitative of the activities he observes in his immediate environment. Fursey (42) and Guillet (48) point out that the rudimentary beginning of dramatic play shows itself during the second year of life.

Norms of play behavior for the babyhood years have been given by Gesell (44) and tests for early play activities have been outlined by him.

b. *Play Materials*

Long and fairly complete lists of toys that appeal to the baby have been given by Arlitt (7), Boehm (14), Heinig (55), Johnson (67), Meek (95), Pyle (103) and others. Ten three-years-olds, observed by Bridges (19) showed a distinct preference for cylinders to be fitted into holes. The favored toys for a group of two-three-year-olds were found by Bott (16) to be mechanical toys.

c. *Time Spent in Play*

There are few studies where an actual record has been made of the duration of the baby's play. Bridges (19) found that the longest

median time three-year-olds would give to any one play activity was 15 minutes. The following percentages of time were given by Bott (16) for the play of three-year-olds: raw materials, 29 per cent; locomotor, 25.3 per cent; pattern, 23.2 per cent; and mechanical, 22.5 per cent. Observations by Herring and Koch (57) of 80 babies showed that the interest span increased with age.

d. Social Participation

Lee (72) has pointed out that at an early age the baby shows slight preference for the father as a playmate. Waddle (123) states that play of babyhood is selfish, self-centered and individualistic while Kirkpatrick (71) has stressed the fact that any attempt to direct the baby's play according to set rules will be resented. Bühler's (22 and 23) observations have shown that by the age of nine months, the baby shows real signs of desiring the play companionship of others. Two months later he begins organized coöperative play activities.

Blatz and Bott (11) have found that the two-year-old is solitary in his play while the three-year-old plays with older children and shows the rudiments of team play. Parten (101) found that at two and one-half years there was more solitary play than at any other age level, while the most common form of social participation was parallel play. Salusky (105) has reported the number of children associated in a "collective" to be 2-3 in 67 per cent of the cases, 4-5 in 18 per cent, 6-7 in 9 per cent, and 8-10 in only 6 per cent. Hagman (52) found that there was no definite preference for playmates of the same or of the opposite sex.

2. CHILDHOOD PLAY (Three to Six Years)

The play of childhood, while carrying over some of the characteristic elements of babyhood play, is nevertheless more highly developed and more complex.

a. Types of Play

According to Arlitt (6) the child who at three can enjoy an activity as an end in itself, at five finds the end result distinctly more important than the activity. In childhood, Hollingworth (59) explains, "play activities pass from the auto-playful stage, through narcissistic, home, and finally hetero-type interests." Kirkpatrick (71) describes the child's activities as simple, free and imaginative. The transitional aspect of childhood play is brought out by Waddle (123) in the statement that "there is in fact no sudden break, but rather an evolutionary change from period to period."

According to Arlitt (7) "imaginative play reaches its height in the kindergarten and primary grades." Kirkpatrick (71) states that nearly all childhood play is colored by the use of the imagination. Lee (72) explains the dramatic play of children as due to the "impulse to understand their world." Shallit (109) found that dramatic play relating to living conditions, animals and family relationships were most frequent among four-year-olds, while activities involving boats, cars and trains were least frequent.

Imitation of people he admires is common in boys' play according to Angell (4). Children will, Crawford and Menninger (30) have observed, imitate "not only the souls of other people and of animals, but of inanimate objects as well." After the age of three, Forbush (37) has discovered the child adapts the act of the adult to some play idea of his own. Imitating such matter-of-fact actions as going to the store, family life, etc., are very popular, Tanner (117) found, with both boys and girls. Imitation of animals has been observed by Palmer (100) to be common among children.

Play involving skilled movements of the muscles is very popular during childhood. According to Gulick (50) the child "loves to do simple things such as run or jump or climb." By the third or fourth year, Palmer (100) found that children enjoy testing their powers of muscular control in such acts as walking on the edge of curbstones, hopping on one foot, etc. Stern (115) has stated that "even swimming and skating can be managed very happily by many a five-year-old."

Interest in construction is an important element in the play of a child. In the fifth and sixth years, according to Freeman (39), "play with objects develops into simple kinds of construction." Wood (128) points out that the most popular game of childhood is "the ancient and glorious game of mudpies." Hulson's (63) observations showed that the chief activity with blocks was building.

Children begin to collect certain things, such as ribbons, cigar bands, etc., and take pride in the number they are able to accumulate. Hall (53) finds that the "collection of miscellaneous trivial things . . . begins at about three or four years of age and lasts to about seven or eight years." Burk (24) agrees with Hall that collecting begins around the age of three and until eight, it is "crude, groping, undirected."

b. *Play Materials*

Bott (16) found that in three-four-year-olds, raw materials such as sand and blocks ranked first as favored toys. For both boys and

girls of the four-year level, making simple patterns with colored crayons proved to be the most popular play material, according to Bridges (20). Doll play has been carefully studied by Hall (53). Dolls representing children are favored by the five-year-old, while adult dolls increase in popularity with increase in age. Farwell (35) found that for both sexes, there was a moderate interest in drawing, cardboard and paper construction materials. Hulson (62) has reported that blocks and sand are the favored materials while dolls, blackboards and animals were the least popular with four-year-olds.

The importance of toys, as an accompaniment of dramatic play, has been stressed by Tanner (117) and Crawford and Menninger (30). Forbush (37) believes that "interest in common objects and toys culminates at the close of this period." Benjamin (9) has reported that a girl doll proved to be the favorite toy of girls while an automobile, airplane and cowboy were more often chosen by the boys. Bühler (21) states that after the age of four, the child uses his play materials specifically to make something out of them, in contrast to mere manipulation which is characteristic of earlier years. Hetzer (58) found that below the age of two, construction was merely "unspecific manipulation," while after the age of two, the construction was first in the form of "specific manipulation," and then in the form of "meaningful manipulation." Van Alstyne (120) found that at the ages of two-six years, blocks, clay and doll corner were the most interesting toys.

c. Time Spent in Play

Bridges (20), in the case of four-year-olds, found that the median time spent in play with a toy was 6.2 minutes. Farwell (35) found that 31.3 per cent of the 271 children studied, worked with one constructive play material from 50 to 100 per cent of the total working time. Shallit (109) reports that the average length of time spent in dramatic play was 7 minutes. According to Van Alstyne (120), the average attention span for the 8 most popular play materials was 7.0 minutes for the two-year-olds; 8.9 minutes for the three-year-olds; 12.3 minutes for the four-year-olds and 13.6 minutes for the five-year-olds.

d. Social Participation

The child's craving for companionship has been stressed by a number of writers. Crawford and Menninger (30) hold that "after the first few awkward attempts at social play, merely the presence of

a little visitor constitutes a sort of game." According to Heinig (55), at "about the age of four, interest in coöperative play becomes paramount." Waddle (123) states that "pleasure in companionship increases, but individual desires dominate."

Much attention has been given to the social organization involved in childhood play. According to Appleton (5), childhood plays are "non-competitive." Blanchard (10) shows that the play of this age consists primarily of unorganized, individualistic play. Bott (16) found that talking and interference were the most common activities while coöperation with other children was least common. Lack of sportsmanship was found by Bush and Rigby (25) to be a common characteristic of childhood play.

In early childhood, Crawford and Menninger (30) have found play to be individualistic. According to Gulick (51) children under seven years of age "care little for the organized games." From two and one-half to four years, Parten (101) found a decided decline in the importance of solitary play, a decrease in parallel play groups and an increase in associative group play.

Salusky (105) has reported that between the ages of two years three months and four years, 40 per cent of the children take part in play groups consisting of 4 or 5 children, 29 per cent in groups of 2 or 3 children, and in large groups of 11 to 20 children, only 5 per cent. Verry (121) has noted 5 distinct social attitudes in the play of preschool children.

The child's choice of play companions has received only a slight amount of attention. Similarity in M.A., I.Q., height, extroversion, personal attractiveness and frequency of laughter were found by Callman (27) to have no influence on friendship. Sex, on the other hand, proved to be a determining factor. Unlike Callman, Chevaleva-Janovskaja (29) reports that the characteristic groups formed between three and five years of age are usually composed of both sexes and that unisexual groups are generally boys' groups. Salusky (105) found a tendency towards one-sex associations among children. Palmer (100) has stressed the fact that children not only enjoy playmates of their own ages but that several years' difference in age is a serious barrier.

Hagman's (52) study indicated that four-year-olds show a decided preference for companions of their own sex while two-year-olds do not. Van Alstyne (120) found that over 50 per cent of the children ranging in age from two to six years, whom she observed, tend to play by themselves when playing with play materials, and in only

about 40 per cent of the observations was the gregarious type of grouping found.

The child's craving for play companionship is very apparent in the formation of "imaginary companions" as substitutes for real companions when no real companions exist. Theoretical studies of "imaginary playmates" have been made by Arlitt (6), Green (47), Monroe (97), Norsworthy and Whitley (98), Kirkpatrick (71), Smith (113), and Tanner (117). The most recent study of imaginary companions was a retrospective study made by Hurlock and Burstein (64).

Adelberg (2) studied the leadership of 3 children to determine which traits led to success in their ability to direct others. Blatz and Bott (11) found the beginnings of definite leadership traits in a group of four-year-old nursery school children.

e. *Differentiation in Play*

Much stress has been placed upon the influence of sex as a factor in determining the play of children. Arlitt (6) points out that what sex differences in play are apparent are due to training. Sex differences in play materials favored by children have been noted by Bridges (19 and 20). The favored constructive play materials for boys and girls have been studied by Farwell (35). Shallit (109) reports that the only real sex difference in the dramatic play of four-year-olds was in the case of boats, cars and trains.

Lee (72) explains the sex difference in play interests in soldiers and dolls as due to an "innate basis." Stern (115) notes a sex difference in constructive games. Waddle (123) contends that up to the age of school life, there are no sex differences in play. Van Alstyne (120) found that similarities in the play of girls and boys in childhood are greater than differences.

Gesell and Lord (45) found that children from good neighborhoods stood far above those from poor neighborhoods in initiative and spontaneity in play. Salusky (105) has shown that the games of children from children's homes are reproductions of the life situations of the home, while in the case of peasant children, the games represent family life and the activities of domestic animals.

3. PLAY OF YOUTH (Six to Twelve or Thirteen Years)

The transitional aspect of the play of youth has been stressed by a number of writers, as Forbush (37), Pyle (103), Hollingsworth (59), Tanner (117), and Waddle (123). Gulick (50) and

Hall (54) have pointed out that there are two outstanding characteristics of the play of youth: (1) a gradual increase in the number of team games engaged in, and (2) strenuous outdoor play is favored above all others, especially among boys.

a. *Types of Play*

The great variety of play activities characteristic of youth has been pointed out by Lehman and Michie (77). The characteristic play activities for boys and girls of the ages eight to eleven years have been investigated by Lehman and Witty (90). Lists of play activities, together with the frequency of occurrence at each age, have been given by them.

Imaginative play is pronounced during the early part of youth. Fursey (42) found that 67 per cent of a group of eight-year-old boys studied by him indulged in this sort of play. According to Lee (72), imaginative play becomes more creative in form, which shows itself in such activities as drawing and construction. Pyle (103) has found that there is a "gradual decadence of make-believe play." Dramatic play of youth, Johnson (66) has pointed out, is not so spontaneous as before, but simple actions are woven together to form a plot. Doll play has been investigated by Ellis and Hall (34) and was found to be most popular between the ages of seven and ten, with a climax between eight and nine.

The youth's interest in pets has been studied by Lehman (75). Boys showed a marked preference for playing with dogs rather than with kittens. The same preference was shown by girls, only in not so marked a manner.

Collecting is very popular during early youth, especially among boys. Burk (24) found this interest to be most pronounced from the ages of eight to eleven years. The most favored objects collected by boys were cigar tags, stamps, birds' eggs and marbles, while in the case of girls, stamps, shells, picture cards and cigar tags were the first choices. Hall (53) found the favored objects of collection to be similar to those listed by Burk. According to Lee (72) "this is the age of hoarding perfectly useless and dilapidated things." Lehman and Witty (89) found that collecting as a play activity comes to a climax at ten years of age. Whitley (126), on the other hand, finds interest in collecting at its greatest intensity from nine to thirteen years. Durost (33) found that collecting is not related to chronological age but is positively related to mental age.

Johnson (66) has found that the "constructive play of this period

will be manifested in large, crude work as in the building of huts, tents, playhouses, etc." Guessing games and games of chance, Hollingworth (59) has pointed out, "become prominent at this stage." At the age of seven or eight, Kirkpatrick (71) has found, games and riddles appeal strongly. Physical skills, involved in running, jumping, vaulting, etc., are developed at the same time as the mental skills.

Competitive play becomes very popular during youth. After the eighth year, Croswell (31) found that play with a strong element of competition predominates. "Games of low organization," such as the running and chasing, come into popularity at about six years of age, Fursey (42) found, and increase in complexity of form and organization with increase in age. Henderson (56) states that from seven to eleven, games are almost exclusively competitive in character. Games of skill become "almost wholly social games of contest" in the latter part of youth, Palmer (100) contends.

The types of games popular during youth have been investigated by Angell (4), Blanchard (10), Foster (38), and Johnson (66).

Termer and Lima (118) have given a detailed description of the type of reading that appeals to boys and girls at each year of the youth period. Interest in reading, Additon (1) found, is the paramount play interest of girls during this age.

What the youth reads when given a free choice was investigated by Jordon (68). Interest in reading the Sunday "Funny Paper" has been investigated by Lehman and Witty (87). Lippert (91) investigated the reading matter that appeals to girls of the pre-puberty years. Schlotte (106) found that a "rage" for reading develops at the eleven to twelve year period.

Attending moving pictures has been studied on a large scale by Mitchell (96). Lehman and Witty (86) found that 80 per cent of boys and girls between the ages of ten and one-half and fifteen and one-half years of age attended moving pictures.

b. *Play Materials*

Unlike childhood, youth is an age when there is little need for play materials. Ellis and Hall (34) found that adult dolls were preferred to dolls representing children or babies by both boys and girls between the ages of six and twelve years. Interest in making doll clothes does not appear until between seven and nine years.

Interest in pets has been studied by Burk (24). The interest shown in dogs by boys and girls increases rapidly from seven to

fourteen years, when it culminates. Girls appear to be more interested in cats than boys and this interest culminates at eleven.

c. *Social Participation*

Many studies of the social participation in the play life of youth have been made. Among the most famous are the studies by Thrasher (119), Fursey (41), and Puffer (102). Puffer (102), Hall (54), Waddle (123), Lee (72), and Fursey (41) agree that the "gang" tendency begins around the age of ten and reaches a climax between twelve and fourteen years. The "plays of the eleven-year-old are," Hollingworth (59) finds, "strongly social in the sense that they involve many players."

The play activities of the "gang," Puffer (102) discovered, include games, athletics, card games, etc. Interest in team games and readiness to join gang activities are, according to Fursey (41), characteristics of the play of youth. The activities of gangs, Block (12) found, are ruled by a "mob spirit" which often leads to vandalism and hoodlumism.

Almack (3) found a tendency to select as companions those of like C.A. and M.A. Blanchard (10) explains the similarity of intellectual level in groups of play companions on the grounds that dull children cannot "keep up" with gang activities while gifted children are bored with them. Fursey (40) discovered that contiguity in school or in the neighborhood, was the most important factor in the formation of play companionships. Being a "good sport" and living in the neighborhood, Puffer (102) found to be the two essentials to membership in gangs.

M.A. is responsible, according to Warner (124), for bringing about the grouping of boys into gangs. Wellman (125) found that among girls, chums were most alike in scholarship. In the case of boys, height, C.A. and I.Q. were most similar.

Puffer (102) has listed the following leadership qualities: age, size, skill in play, good fighter, desire to lead, etc. Block (12) holds that ability to "scrap" together with fairmindedness in disputes, is the essential quality of a gang leader. Age and intelligence, Warner (124) found, above that of the other members of the group, are essential in leadership. Caldwell and Wellman (26) hold that the outstanding characteristics of leaders vary with the types of activity engaged in.

d. Differentiation in Play Activities

The factors influencing the play of youth are:

1. *Sex.* Hall (53) found that 76 per cent of boys and 99 per cent of girls play with dolls. The play of girls is less strenuous than that of boys. This, Hollingworth (59) explains, is due to "social pressure." Croswell (31) has pointed out that boys are less affected by convention in their selection of play interests than are girls, while girls have a larger repertory of play activities. McGhee (94) has stressed the fact that boys have more definite play preferences than girls, while girls engage in a large variety of play activities. Curtis (32) holds that girls do not have the same interest as boys in competitive play, and they are slower in developing the coöordinations necessary for most games.

Lehman and Witty (90) found that in the play activities of girls, only 16 of those most often participated in required mechanical ability and motor skill, while in the case of boys, 37 required such abilities. Sex differences in collecting interests were reported by Lehman and Witty (89) for nine, ten and eleven year groups. Only slight sex differences were found by Lehman and Witty (87) in the interest youth displays in looking at the Sunday "Funny Paper." From five and one-half to eight and one-half years of age, Lehman and Witty (90) state that "there is a conspicuous tendency for boys to engage more frequently in extremely active plays and games." In their study of reacting interests, Terman and Lima (118) found that in the case of boys, interest in stories of adventure and mystery was predominant, while girls' first interests were in stories of home and school life.

2. *Intelligence.* How intelligence influences the range of play interests has been investigated by Lehman and Michie (77). In a similar study, Lehman and Witty (81) found that gifted children were solitary in their play and tended to avoid vigorous physical play. How school progress influences social play was also investigated by Lehman and Witty (82). Studies by Shambaugh (108) have revealed that gifted children must have a good understanding of the game to get real satisfaction from it.

Terman and Lima (118) found that gifted boys preferred books dealing with science, history, travel and folk lore while boys of average intelligence preferred adventure and mystery stories. Huber (61) found that dull children preferred the humorous and "familiar experience" type of reading while bright children were

more influenced by the literary quality of the reading material and less by its content.

3. *Race.* The play of negro children, Lehman and Witty (88 and 90) found, is distinctly more social than that of white children at every age from eight and one-half to fifteen and one-half. They also found (83) that negro children play school more frequently than white children. Scruggs (107) found that to the majority of negro children, Bible stories were more interesting than any other type. Lehman (74) found that negro children play more with jacks and marbles than do white children, while in an investigation made by him in collaboration with Witty (83), he reports that negro children play school more frequently than do white children. Smith (112) made a comparison of the play of Japanese boys with that of American boys.

4. *Environment.* Bobbett (13) has shown that rural boys of the ages of eight to ten indulge in fewer forms of play than do city boys of the same age while the opposite is true for older boys. Chase (28) found that the most popular games of the tenement districts in New York City were those that required little space. Lehman (74) discovered that in a university town more football, basketball and marbles were played than in other types studied by him, and (76) that country children attend moving pictures less than town children. In a study by Witty and Lehman (127) it was found that rural children collect many more objects than do city children.

4. PLAY OF ADOLESCENCE (Twelve or Thirteen to Twenty-one Years)

Although adolescence is one of the most interesting as well as one of the most vitally important periods of development, fewer scientific studies have been made of the play of this period than any of the others preceding it.

a. *Types of Play*

The most important form of play of adolescence is group play, in the form of games and athletic contests, where strict rules and regulations control the entire play activity. Fursey (42) stresses this love of group play when he states that "whereas a couple of years ago he was satisfied with relatively informal games, he now gives his allegiance to the standard team games." Hollingworth (59) states that "although individual competition is still strong, socialization appears even more markedly than in the plays of the 'Big Injun' age." Fursey (41) found that with the onset of puberty, gang play gives way to organized athletics.

Lehman and Witty (79) found that after the age of nine and one-half years, there was a rapid decline in the percentage of girls of each age group who played with dolls, the most rapid decline coming between eleven and one-half and thirteen and one-half years. Baldwin (8) reported similar results while Hall (53) found that the only interest in dolls which survived puberty was interest in children or baby dolls.

A number of studies have been made of the types of play that lose their interest for the adolescent. Fursey (41 and 42) found that after fourteen, there was a marked decrease in interest in gang play and scouting, and (43) that activities which were predominantly manipulative, dramatic or individualistic were subject to a sudden loss of interest. Lehman and Witty (79) similarly found that the onset of adolescence was accompanied by a waning of interest in youthful activities. Monroe (97) has reported a decline in interest in marbles and hide-and-seek after the age of twelve. McGhee (94) indicates a decline in interest in doll play, make-believe and imitative play. Hall (53) found that from fourteen on, there is a distinct decline in imitative games while dramatic play, if it survives at all, is modified into the vaudeville type. Likewise, collecting wanes in interest. Wood (128) agrees with Hall, but stresses the fact that it is more pronounced in boys than in girls.

Teriman and Lima (118) found that at eleven years, reading interests are very similar to those of the period of youth, but that by twelve, the "climax of the reading craze," there is a pronounced interest in any kind of book, especially those that cater to the "hero-worship" tendency. From fifteen on, less time is given to reading, because of the pressure of school work. Jordon (69) analyzed the reading interests of high school pupils and found a marked increase in adult fiction, towards late adolescence, and a marked decrease in interest in juvenile fiction. Orr and Brown (99) investigated the out-of-school activities of high school students and discovered that 88 per cent of them read books other than those connected with their school assignments. Johnson (66) believes that the reading interest, characteristic of youth, culminates at about the age of thirteen.

Participation in fortune-telling activities was found by Lehman and Witty (84) to be especially popular from the age of twelve and one-half through fourteen and one-half.

Orr and Brown (99) found that in the case of high school girls studied by them, 39 per cent attended theaters or movies as much as once a week. Hollingworth (59) reports that boys attend more than

girls. Sullenger (116) investigated the moving picture preferences of 3,295 high school students.

The "favored" plays of adolescence have been investigated by a number of writers. Notably, Monroe (97), Additon (1), Lehman and Witty (90), and McGhee (94).

b. Social Organization of Play

Typically, the adolescent chooses as his play companions individuals of his own age or older, and he develops a marked snobbishness towards his associates.

At this age, according to L. S. Hollingworth (60), tastes in friendship are well established. According to Bonser (15) about 75 per cent of the boys and girls choose their companions from those considerably older or younger than they. Fursey (42) found that the companionship of older boys was more satisfying than that of boys who had formerly been their chums.

Bowden (17) investigated the importance of physical characteristics in leadership and found them to be the least important of all characteristics. The relationship between leadership and college grades was found by Sheldon (110) to be 0.19 and between leadership and intelligence test scores, 0.06. McCuen (93) found that the average of the leaders' scores on intelligence tests was only 3 points above the average of all the scores.

c. Differentiation in Play Activities

The influence of the sex on adolescent play has received more attention than any other one factor. Hollingworth (59) points out that during adolescence, "there is also a tendency for boys to organize games and enterprises at which girls will be spectators." In adolescence, Freeman (39) holds, boys are conscious of the approval and favor of the girls who are spectators of their combats. In the case of adolescent girls, Wood (128) has found that there is a loss of interest in active games and an awakening of interest in nature and animals.

Sex differences in reading interests have been pointed out by Jordon (68 and 69) and Lehman and Witty (90). Sex differences in reading books, "just for fun," were studied by Lehman and Witty (85). A sex difference in favor of the boys was found by Hollingworth (59) to exist in attendance at moving pictures. Sullenger (116) likewise found sex differences in moving picture preferences.

Terman and Lima (118) have reported that boys and girls in

rural and industrial communities read less than those of well-to-do urban communities.

A striking racial difference in writing poetry, "just for fun," was discovered by Lehman and Witty (85) in the case of white and negro adolescents.

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STANDARDS FOR THE PH.D. DEGREE IN PSYCHOLOGY

BY THE AMERICAN PSYCHOLOGICAL ASSOCIATION'S
COMMITTEE ON THE PH.D. DEGREE IN
PSYCHOLOGY

A questionnaire on the topic of standards for the Ph.D. degree in psychology was sent to psychology departments in the following universities: Brown, California, Chicago (including the Department of Education), Clark, Columbia, Cornell, Harvard, Hopkins, Illinois, Iowa, Michigan, Minnesota, North Carolina, Ohio, Peabody, Pennsylvania, Princeton, Stanford, Teachers College of Columbia, Toronto, Wisconsin, and Yale. All departments replied, and all were given an opportunity to correct possible errors in the Committee's first tabulation of the replies.

The Committee interpreted its task as one of fact finding and not one of criticism of existing procedures. The present report, therefore, contains no recommendations, and none are contemplated for the future. The questionnaire called for a statement of *present* practices and also of *desirable* practices. Since the returns usually made no distinction of this type, the following report represents a close approximation to the actual practices in the departments concerned.

I. ADMISSION TO GRADUATE WORK IN PSYCHOLOGY

1. Should the applicant have training in science other than psychology? If so, in what sciences, and how much in each?

<i>No requirements</i>	<i>Physics</i>	<i>Chemistry</i>	<i>Biology</i>	<i>Mathematics</i>
Brown	Chicago	Chicago	California	Chicago
Chicago (Dept. of Education)	Clark	Clark	Chicago	Clark
Columbia	Cornell	Princeton	Clark	Hopkins
Peabody	Hopkins		Cornell	Stanford
Harvard	N. Carolina		Hopkins	
Iowa	Princeton		Michigan	
Ohio	Michigan		N. Carolina	
Pennsylvania			Stanford	
Teachers College				
Toronto				
Wisconsin				
Yale				

At *Chicago* the applicant must present either one course each in physics and chemistry or two courses in either one. At *Illinois* the applicant must choose two sciences from zoölogy, physiology, mathematics, physics, and sociology-anthropology. At *Minnesota* there is no uniform departmental requirement, although the four basic sciences are emphasized in varying degrees. At *Michigan* mental hygiene and clinical psychology students may be exempted from the above requirements. At *Toronto* students usually have three years of one natural or one social science. The requirements tabulated above are usually for one year of college work. In mathematics only three institutions specify that work shall be done through calculus.

The returns indicate that most departments in column one would prefer and advise the applicant to have some scientific training outside of psychology, with chief emphasis upon biology. The departments listed in the other columns, in some instances, advise students to take science courses in addition to those specified as required. In addition to biology, physics, chemistry, and mathematics, the following subjects are suggested as important for the psychologist: anthropology, philosophy, and social science.

It should be noted that formal requirements for admission to graduate study in psychology may be difficult to enforce where admission to the Graduate School is open to all holders of the A.B. degree. In such cases the departments can enforce their requirements only after the student is admitted and prior to his admission to candidacy for the doctor's degree.

2. Should the applicant have certain language training? If so, in what languages, and how much in each?

German, required for admission as course credit or by tests: California, Harvard, Hopkins (usually), Michigan, Minnesota, Stanford.

French, required as above: California, Harvard, Hopkins, Minnesota, Stanford.

German or *French*, required as above: Chicago, Clark, Toronto (usually).

No requirements: Brown, Chicago Department of Education, Cornell, Illinois, Iowa, North Carolina, Ohio, Peabody, Pennsylvania, Princeton, Teachers College, Wisconsin, Yale.

The returns show that there is almost no dissent from the current practice of requiring a reading knowledge of German and French prior to granting the doctor's degree. Only nine of the twenty-three

departments, however, *require* some of this training *prior to admission* to graduate work.

3. Should the applicant have a certain specified rank in his graduating class; for example, should he be in the upper quartile or should he have a certain average letter grade during his junior and senior years? (Such a rating might serve as an indication of the applicant's general intelligence.)

Departments answering "yes": Brown, California, Clark, Harvard, Hopkins, Iowa, Michigan, Minnesota, North Carolina, Princeton, Stanford, Teachers College, Wisconsin, Yale.

Departments regarding the policy as either undesirable or unimportant: Chicago, Cornell, Peabody, Pennsylvania, Toronto.

4-5. Should the prospective graduate student in psychology be *discouraged* from taking large numbers of psychology courses at the sacrifice of work in the basic sciences and in language? Can Question 4 be quantified by indicating a desirable maximum and minimum of courses in psychology to be taken by the undergraduate contemplating graduate work in psychology?

Students should be so discouraged: Brown, California, Chicago, Clark, Cornell, Peabody, Illinois, Iowa, Hopkins, Michigan, Minnesota, North Carolina, Princeton, Stanford.

Policy not practiced: Harvard, Ohio, Pennsylvania, Wisconsin, Yale.

At *Chicago* the junior-senior years of the College involve 18 courses. For psychology majors, 6 of these are in psychology, 6 are in related fields, and 6 are free electives. *Toronto* sets limits to the amount of psychology for pass and honor students. *Hopkins*, *Clark*, and *Illinois*, in their replies, stress the desirability of limiting major students to the minimum number of courses in psychology necessary to satisfy the major requirements of the college in order that the student may secure basic training in science and language while satisfying the bachelor's degree requirements.

II. GRADUATE WORK

1. If the student lacks any undergraduate training specified under Question 1 above, should he be required to make up this deficiency during his graduate work?

Departments answering "yes": California, Chicago, Clark, Hopkins, Michigan, Princeton, Stanford, Wisconsin(?).

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Departments answering "no": Pennsylvania.

Departments answering "partly": Brown, Chicago Department of Education, Cornell, Harvard, Illinois, Iowa, Minnesota, North Carolina, Ohio, Peabody, Teachers College, Toronto (deficiencies in psychology made up, but not in other sciences), Yale.

The returns thus indicate that some of the departments that specify certain basic sciences for undergraduate training do not *require* these sciences either for admission to the graduate school or for the doctor's degree. The third category of replies, above, recognizes a general practice for graduate departments to require, or to advise strongly, that some work outside the department be taken.

2. Should a student be required or encouraged to minor in a physical or biological science for the Ph.D. degree?

The system of minors does not exist at California, Chicago, Columbia, Harvard, Hopkins, Michigan, Ohio, Pennsylvania, Princeton, and Yale. Elsewhere only Brown, Clark, Cornell, Iowa, and Toronto tend to favor a requirement of a minor in the physical or biological sciences.

3. If the student minors in some subject other than the natural sciences, should he be required to have some knowledge of these sciences? If so, of what sciences?

Should be required: Brown, California, Chicago, Clark, Cornell, Hopkins, Iowa, Minnesota, North Carolina.

Should be recommended: Columbia, Peabody, Harvard, Illinois, Iowa, Ohio, Pennsylvania, Princeton, Stanford, Teachers College, Toronto, Yale.

4. How many of your Ph.D.'s have minored in each of the available subjects during each of the past five years?

The following tabulation is for those universities having minors. In some cases the minor was taken in some branch of psychology. These cases are omitted unless they can be classified in some field other than psychology. Biology, 34; Education, 40; Mathematics, 5; Philosophy, 6; English, 3; Physics, 1; Social Science, 10; Speech, 2.

5. Are there certain subjects, or fields, in psychology with which all candidates for the Ph.D. should be reasonably familiar? (For example, experimental psychology, statistics, history, animal behavior, etc.)

With one or two exceptions in each case all departments *require work in experimental psychology, statistics, and history-theory.* Most

departments at least recommend a general acquaintance with the science as a whole. In some cases a pro-seminar (Yale) or orientation course is given at the graduate level; in other cases the student takes separate courses in the different subjects. In one instance (Harvard) the preliminary examination for the doctorate is so arranged that the student must present himself for examination in history, theory, and experimental psychology, and he must choose one other field for examination from comparative, abnormal, social, and educational psychology.

6. Should students specializing in such fields as educational, child, or social psychology be excused from rigorous training in the basic sciences or in experimental psychology?

Departments answering "no": Brown, California, Chicago, Chicago Department of Education, Clark, Columbia, Cornell, Harvard, Hopkins, Iowa, Michigan, Minnesota, North Carolina, Peabody, Pennsylvania, Princeton, Stanford, Wisconsin.

Departments answering "yes": Illinois, Teachers College, Toronto, Yale (with qualification).

In so far as the Ph.D. is based on work in the psychology departments, the answers to this question and to Question 5 indicate that *training in experimental psychology is fundamental and required for all psychologists*. Where the doctor's degree is not under the control of the psychology department, as is frequently the case in child and educational psychology, no such standard seems to be followed, although the opinion of psychologists is that it should be. (Departments in Group 2 above, as well as those in Group 1, vary the emphasis upon "outside" subjects in terms of the student's particular problem or field of concentration.)

The answers to Questions I-1 and II-1, relating to training in the basic sciences, show that the Ph.D. degree, even when controlled by the psychology departments, carries with it no guarantee of an elementary acquaintance with the basic sciences.

7. Can the standard of the Ph.D. be adequately maintained by the system of preliminary and final examinations alone?

All departments agree that there must be close personal contacts with the candidate which will enable the department to evaluate his research ability and scientific imagination. The answer to Question II-5 would also indicate that a knowledge of certain specific fields of psychology must be secured by the candidate, apparently through the medium of required work. However, only certain departments

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believe that a *requirement* of a knowledge of the basic sciences is also necessary for the maintenance of a high standard for the degree.

8. What is the present character of your preliminary and final examinations? What modifications of these would you recommend, if any?

There is a very great diversity in the actual practices of the different departments with respect to the preliminary and final examinations. All departments require a final oral examination which is usually upon the subject matter of the thesis, although sometimes on the field of the thesis. In one instance, the final oral examination may be waived at the option of the department. In at least two cases the final examination is both written and oral. Preliminary examinations are usually held one year before the degree is expected. These examinations vary in length from four hours to six successive or alternate half days. In the great majority of cases they are written, but oral preliminaries are also given in at least five instances. The examinations are usually of the essay type, although some use of objective tests has been noted. The procedure at Yale is covered in the following quotation: "Before the final year of Ph.D. work a student must have passed a written examination on the fields covered by the pro-seminar; assured us by certification, or otherwise, of his competence in statistical and in experimental method; and he must pass a more searching examination either written or oral, or both, on his specific area of concentration out of which his dissertation subject has developed. . . . In the final year, after his thesis has been approved, the candidate takes a final oral examination before the department, and certain invited guests from other departments, on his dissertation and its general scientific implications."

In addition to the above study of the Standards for the Ph.D. Degree in Psychology, the present committee has also made an analysis of the problem of supply and demand for psychologists. This analysis will be found in the Proceedings of the American Psychological Association, Chicago Meeting, 1933, published in the *PSYCHOLOGICAL BULLETIN*, Vol. 30, pp. 648-654.

(Signed) E. G. BORING
H. A. CARR
L. M. TERMAN
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W. S. HUNTER, *Chairman*

BOOK REVIEWS

COMMITTEE ON GROWTH AND DEVELOPMENT OF THE WHITE HOUSE
CONFERENCE ON CHILD HEALTH AND PROTECTION. *Growth and
Development of the Child. Pt. IV. Appraisement of the Child.*
New York: The Century Co., 1932. Pp. xix+344.

As the details of the reference indicate, the volume to be reviewed is one of a series of four which constitute the report of the Committee on Growth and Development of the White House Conference on Child Health and Protection. The aim of this particular volume is to assess existing knowledge descriptive of growth and development, to point out obstacles to normal growth, to make clear where data and techniques essential to an intelligent evaluation of development are lacking, as well as to represent adequately the views of the laboratory worker, educator, and clinician. Among the contributors—each has offered his bit anonymously—are 35 of the most illustrious workers in the fields of psychology, psychiatry, physiology, pediatrics, anatomy, education, and anthropology. While one may infer that each of the various chapters is largely the work of a single individual, the view presented is alleged always to represent the consensus of the opinion of the group.

With the nature of the volume what it is, one finds, of course, that the material presented is not essentially new, though it portrays commendably the most recent advances in appropriate areas of the various scientific fields. The direction of the opus—it has no real focus—is somewhat different from any with which the reviewer is familiar, the territory it illuminates being more extended than is usual. We have been provided with manuals concerning mental tests and physical anthropology, etc., for instance, but here we have within the compass of one cover a brilliant treatment of the problems of the appraisal of physical, mental, and social development. Eclecticism in its best form is illustrated.

The very scope of the material which might be dealt with has, however, created some difficulties. Unless one describes thoroughly his tools and procedures—their derivation, the bases for accrediting the results obtained by the use of the tools with reliability or validity, the many variables which may influence or fog returns—the reader who is seeking guidance in their employment is likely to be led into

misinterpretations or, at least, unintelligent hypothesis building. Almost endless detail would appear to be necessary if a treatise on human appraisement were to be adequate, as human development is no simple matter. It is obvious, then, that our 344-page large-type volume could not be posing as such a work. With few exceptions, tools have been described rather generally, the more frequent classes of misinterpretations have been exposed, and difficulties attendant upon the derivation as well as application of the appraisement devices have been set forth. One must not, accordingly, pick up the volume with the expectation of discovering what a child of a certain age ought to do or be. In a few instances where concrete standards have been offered, they probably confuse, even though presented with appropriate caution, as not enough detail is given to keep even the intelligent reader from going afield. It is stated, for example (p. 85) that one may expect an infant of two days to hold his head up when upright, and an infant of seven days to turn over as well as to creep. If one desired to be facetious, he might point out that Shirley, whose excellent data, by the way, have received no mention, observed one child who accomplished the feat of turning over on the first day of his life. With such performances, however, as rare and as much a function of a unique set of circumstances as they are, it is very doubtful whether they should be included in a list of developmental standards for the neonate.

The reviewer has been disturbed, too, by the presentation (p. 193) of a number of personality test reliability coefficients with no comment regarding the methods employed in obtaining them or the homogeneity of the groups responsible for the experimentalists' findings.

As we have implied earlier, the text, since it represents the semi-independent contribution of so many different workers, does suffer also from some repetition, some unevenness in the thoroughness with which basic considerations are expounded, and a certain lack of focus which results in surprising omissions as well as unexpected emphases. Language development, to illustrate, is given a very brief treatment, while to motor development are devoted three chapters; the effect of social environment on intellect is discussed at length, while the former's influence on delinquency is dealt with very sketchily; the minutiae of roentgenographic procedures most satisfactory for recording and analyzing changes in bone growth are presented while many other techniques valuable for estimating development are merely named.

Although lacking in focus, the material offered is of the high caliber its authorship would lead us to expect. Since, however, the report is supposed to represent the consensus of the opinion of the Committee, the reviewer was somewhat startled to find a few statements such as the following: "Pretense does not often persist much beyond early adolescence, and life in the imaginary country ceases before maturity, in the course of normal development" (p. 136). "The statistical correlation between physical and mental development is about 0.5" (p. 331). "Under the influence of sadness and depression the heart beats slower" (p. 149). "In addition to this group of natural reactions [reflexes mostly had been mentioned], there are the conscious states called emotions" (p. 149). "Every impulse carries with it some emotion, and this combination furnishes the only motive force of much consequence to the individual and society" (p. 149). In the light, too, of Nancy Bailey's finding for part of the first half year of life of a negative r between parental education and a developmental index based upon test procedures similar to those current, one might query whether it is time to take the attitude expressed on page 95, "It is a question whether at the very youngest ages it will be possible or *even desirable* to attempt an absolute separation [between motor and intellectual development]."

Since the limitations we have mentioned are not gross and probably are an inevitable result of the coöperative nature of the enterprise, we might do better to celebrate the compensating strength of the work—catholicity in point of view, a minimum of dogma, an excellent exposure of the problems needing solution, etc. One is never permitted to lose sight of the infinite complexity of the task of evaluating human development. As an antidote, then, for wholesale diagnosis as well as a general source of information concerning those appraisement methods at present available, the volume should have its widest use. It has possibilities as a text book.

HELEN L. KOCH.

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WHITE HOUSE CONFERENCE ON CHILD HEALTH AND PROTECTION.

Psychology and Psychiatry in Pediatrics. The Problem. Report of the Subcommittee on Psychology and Psychiatry. Bronson Carothers, Chairman. New York: The Century Co., 1932. Pp. xiv+146.

Discusses the question as to whether the field of diagnosing and treating the behavior difficulties of normal children should be regarded

as primarily the province of the psychiatrist, the psychologist, the educator, or the pediatrician. Little evidence is offered apart from citation of individual points of view, but the consensus of opinion appears to be that since many cases of this kind are taken to pediatricians it would be desirable for the pediatricians to become better equipped to handle them.

The appendix, which occupies more than half the book, quotes the letters which were sent out requesting opinions, and gives reports from several organizations dealing with problem children, describing their organization and methods.

FLORENCE L. GOODENOUGH.

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JERSILD, ARTHUR T. *Child Psychology.* New York: Prentice-Hall, Inc., 1933. Pp. 445.

This new textbook on child psychology will be welcomed by psychologists, parents and teachers of young children, since it brings up to date a subject which is changing almost from day to day.

Although the text is not specifically limited to definite age levels, it is quite evident that the author's primary interest is in the preschool period. This emphasis is probably due in part to the many recent additions to our knowledge of this age-group. The person who expects the text to carry the child through to adolescence will be disappointed in some sections.

At first it is somewhat disconcerting to have the text interrupted so frequently by the names of the workers who have contributed each bit of data, but after a few chapters, the reader becomes accustomed to this and is able to ignore the irritation. Such direct reference to the investigator is, of course, a praiseworthy method of giving credit where credit is due, but the chapters would read more smoothly if these references were given less conspicuous positions. Apart from this minor point, Dr. Jersild has worked his material together so cleverly that some chapters leave the reader with the feeling that they must have been outlined first and the sub-topics then assigned to many investigators scattered over the country.

Some parts of the book give evidence of much greater interest and enthusiasm on the part of the author than do others. The chapters on the new-born child and those on emotions are particularly interesting. The discussion of the development of language, on the other hand, is disappointing and distinctly below the high level of the rest of the book. In general the statements made are easily comprehended

and will not arouse dissension, although we may question the prediction that if the families of gifted children continue to grow smaller to "such proportions as to be felt in the practical affairs of the world, the increased premium upon children with high intelligence would lead superior parents to have a greater number of children" and we may question the definition of "inferiority" which applies the term "to the individual whose aspirations are greater than his attainments."

The author has taken a most happy stand on the application of scientific findings to the practical treatment of children. He gives due recognition to the value of the scientific contributions but refuses to let a small accumulation of scientific data sweep him away from a common-sense view of the child's problems. We read, for example, "It is true that, in the light of present evidence, there appears to be some transfer of training; but it is most practical, it would seem, to proceed as though there were very little transfer" and later "even though punishment may be abused, a sweeping statement to the effect that it should never be used would be dogmatic. Until the world has been made perfect, and parents, neighbors, and teachers alike have been converted into a band of coöperative, nimble-witted, and eloquent saints, corporal punishment will continue to be a helpful device in child training."

In summary, we may say that Dr. Jersild's "Child Psychology" is an elementary textbook which presents sound scientific investigations in such a way that they are clear, accurately reported and distinctly interesting.

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RECKLESS, W. C., and SMITH, M. *Juvenile Delinquency*. New York and London: McGraw-Hill Book Company, Inc., 1932. Pp. viii+412.

The general task which the authors have set for themselves through this volume is to present a statistical summary of all data pertaining to Juvenile Delinquency. The data are interpreted and remedies are suggested for present conditions.

Paramount among the factors causing delinquency we find: physical and mental traits, social background and social maladjustment. A clinical study of causation yields other enlightening material. In frequency of occurrence, mental abnormalities and peculiarities rank first, though it is clearly stated that no one factor is the sole cause for delinquency. Various techniques for approaching

the child's world are mentioned; the emphasis being placed upon Shaw's Family Interview Technique.

Together with the developmental history of the Juvenile Court we find a statement of the jurisdiction over which the court has power; a table of distribution of courts; duties of the judge presiding in juvenile courts; types of homes and institutions to which offenders are committed.

The care received by the offender when committed to any one of these homes or institutions shows close relationship to other penal institutions. However, a trend towards individual care and correction is gradually making its appearance.

The most important part of the book is that which deals with preventive programs, and a short section that deals with the results of treatment. Boys' clubs, Y.M.C.A., Boy Scouts, and playgrounds, each with its particular contribution to offer to the welfare of Juvenile Delinquency, are mentioned by the authors as being the logical points to attempt improvement in this matter of prevention.

P. E. DODGE.

Yale University.

History of Psychology in Autobiography. Vol. 2. Carl Murchison (Ed.). Worcester: Clark University Press, 1932. Pp. xvii+407.

The second volume of this exceedingly interesting and very valuable series contains autobiographies of Benjamin Bourdon, James Drever, Knight Dunlap, Giulio Cesare Ferrari, Shepherd Ivory Franz, Karl Groos, Gerardus Heymans, Harald Höffding, Charles H. Judd, C. Lloyd Morgan, Walter B. Pillsbury, Lewis M. Terman, Margaret Floy Washburn, Robert S. Woodworth, and Robert Mearns Yerkes.

Mr. Murchison promises another volume this year and a fourth will come soon. Others will appear at intervals of three to four years.

F. R. ROBINSON.

New Haven.

NOTES AND NEWS

INTER-SOCIETY COLOR COUNCIL

THE delegates of the American Psychological Association to the Inter-Society Color Council wish to call attention of members and associates of the Association, and of others who are interested in problems of color, to the activities of the Council and to the mutual profit which may be effected by coöperation with it. The Council is anxious to assist, in so far as it can, anyone who has color problems and it solicits information on new material in the field. As one means for carrying out this program, the Inter-Society Color Council has begun the publication and circulation among its members of a monthly news letter. This news letter will carry informal reports of experimental work in the field of color, abstracts of articles, and other reports that are of value and interest in the field of color. Copies of the news letter may be obtained by communicating with one of the delegates. We shall appreciate communications from members of the Association on the subject of color.

FORREST L. DIMMICK, Hobart, *Chairman.*

CLARENCE H. GRAHAM, Clark.

SIDNEY M. NEWHALL, Yale.

THE following deaths have recently been reported: Martha Muchow, of Hamburg, on September 29; Eleanor Acheson McCollough Gamble, of Wellesley College, on August 30; Otto Lippman, of Berlin, on October 7; Cloyd N. McAllister, of Berea, on October 31; Mary Hoover Young, on November 24.

THE following items have been taken from *Science*: Dr. J. McKeen Cattell, editor of *Science*, was given a dinner at the University Club, Boston, at the time of the meeting of the American Association for the Advancement of Science. Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, presided, and Dr. John Dewey, emeritus professor of philosophy, Columbia University, made the principal address. Norman Powell, psychologist at the classification clinic, Sing Sing Prison, has withdrawn from the editorship of *The Psychological Exchange*.

THE title of emeritus professor of psychology in the University of London has been conferred on Dr. Beatrice Edgell, on her retirement from the professorship of psychology at Bedford College.

THE Division of Anthropology and Psychology of the National Research Council has published in mimeographed form a set of 43,200 dissyllable words and paralogs which were compiled under the direction of Dr. Knight Dunlap. It is hoped that this material may constitute an ample supply for the preparation of standardized lists for practice, learning and memory studies where large quantities of material are frequently needed; and that some degree of coöperation among laboratories may be developed in the making up of such lists. Directors of laboratories and investigators who have not received copies of this material may do so by applying to the Division of Anthropology and Psychology, National Research Council, 2101 Constitution Avenue, Washington, D. C.

THE Midwestern Psychological Association will hold its ninth annual meeting as guests of Purdue University, Lafayette, Indiana, May 10-12, 1934, under the presidency of Dr. J. J. B. Morgan.

THE EIGHTH INTERNATIONAL CONGRESS OF PHILOSOPHY IN PRAGUE, 1934

By vote of the Permanent International Committee of the 8th of September, 1930, in Oxford, the next International Congress of Philosophy will take place in Prague, Czechoslovakia, in 1934.

After consultation with many friends abroad, the Organizing Committee fixed the date of the assembly September 2-7, 1934, and has the honor to invite to the Congress all members of the last Congress, all philosophers by profession, all those who in the sphere of their work are interested in philosophy. It invites especially men of science, pedagogues, technical men, social workers, clergymen, artists, writers, editors, politicians, in short, all who expect from philosophy help for the work in which they are engaged.

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